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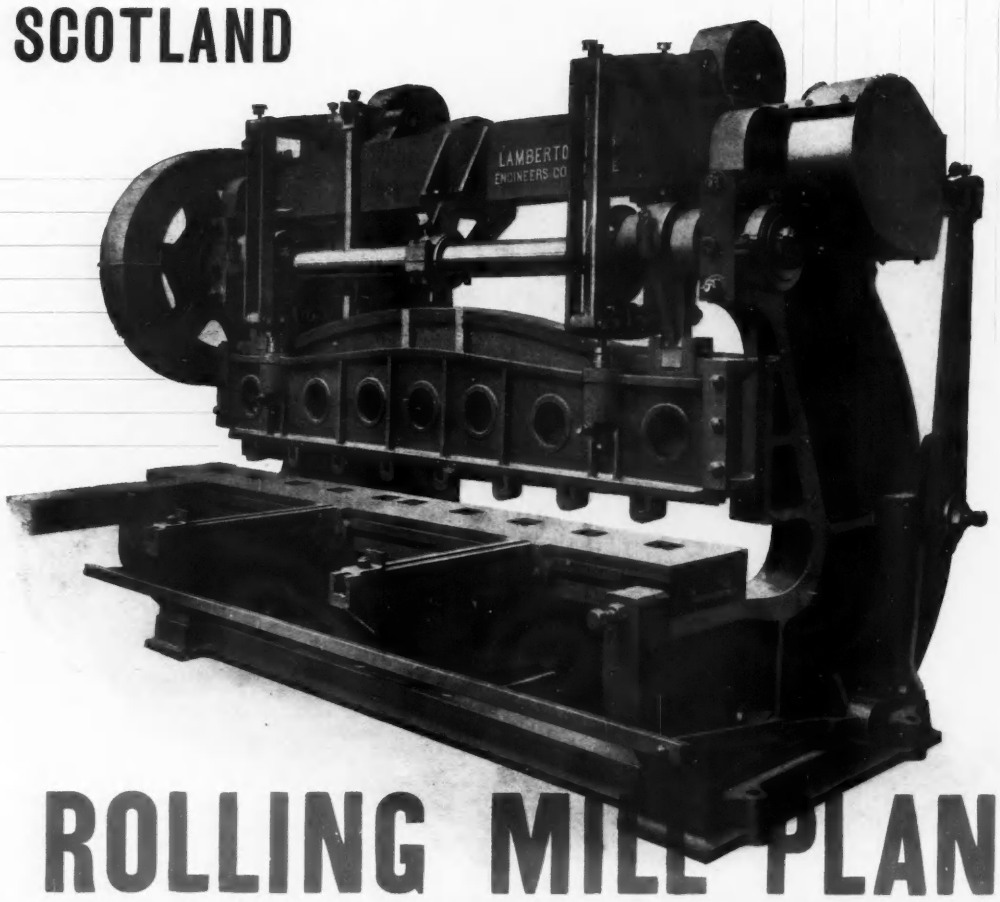

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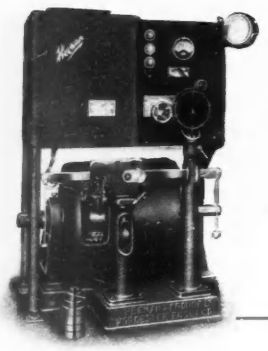

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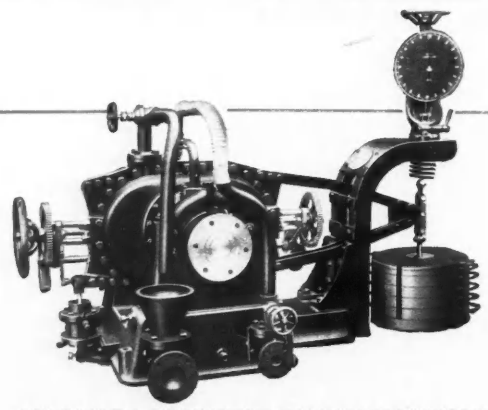

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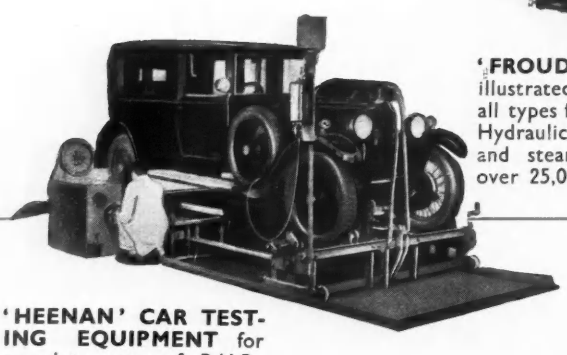

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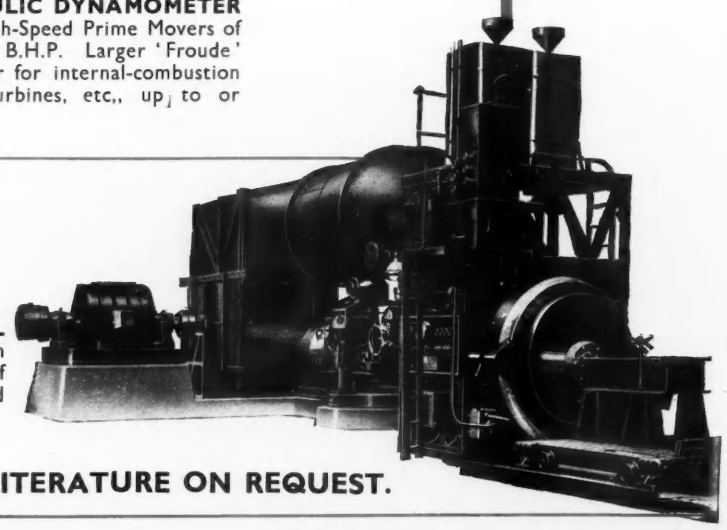

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A Seven-Day Journal

The Late Mr. L. P. Sidney.

IN the world of iron and steel few men were better known than Mr. Leicester P. Sidney, whose sudden death on Saturday last leaves a serious gap in the ranks of technical journalism. For eighteen years he was assistant secretary in the Iron and Steel Institute, and after his retirement from that office devoted himself wholly to journalism, and for nine years was editor of *The Metal Industry*. He was a man of exceptionally wide reading, and with a great diversity of scientific and literary interests. But the iron and steel industries from all aspects was the subject which he had made his own, and on which he possessed a knowledge gleaned in many parts of the world from observation and contact with the men engaged, and from that close study of technical questions which his duties at the Iron and Steel Institute involved. But though a specialist in iron and steel, he kept himself in touch with the leading movements of the day, and could talk with some knowledge of most of them, whilst his taste for good reading gave him a literary style, sometimes a little lacking in restraint, better than that found usually amongst technical men. His practical experience of the iron and steel and allied industries was extensive. As a young man he worked under Mr. Frank Harbord, at the South Staffordshire Steel Ingot Company, Bilston. Thence he went to the works of the Patent Shaft and Axletree Company, and leaving it was for nearly seven years chief metallurgist to the Skelton Iron, Steel, and Coal Company, Ltd., Etruria. Then for a time he engaged in journalism before joining the staff of the Iron and Steel Institute. His subsequent work for the Louis Cassier Company, Ltd., was not only the editorship of *The Metal Industry* under the direction of Mr. E. G. King, the managing editor, but he assisted also in the foundation of *The Iron and Steel Industry*. He made a niche for himself in technical journalism which it will be difficult to fill.

The Unemployment Figures.

ACCORDING to a statement issued by the Ministry of Labour, it is estimated that at February 25th, 1935, there were approximately 10,081,000 insured persons, aged 16–64, in employment in Great Britain. This was 28,000 more than a month before, and 136,000 more than a year before. There was a considerable improvement, between January 28th and February 25th, in employment in the building, tailoring, and boot and shoe industries, and some improvement was also recorded in public works contracting, in the woollen and worsted industry, and in shipping service. On the other hand, there were marked increases in the numbers temporarily suspended from employment in the coalmining industry, mainly in Yorkshire and South Wales, and there was a slight decline in employment in the cotton industry, in dock and harbour services, and in the distributive trades. On the same date the numbers of unemployed persons on the registers of employment exchanges in Great Britain were 1,840,136 wholly unemployed, 353,548 temporarily stopped, and 91,779 normally in casual employment, making a total of 2,285,463. This was 39,910 less than the number on the registers at January 28th, 1935, and 32,446 less than a year before. The total on February 25th, 1935, comprised 1,802,247 men, 71,980 boys, 346,730 women, and 64,506 girls. In the February figures above given the seasonal and climatic conditions have balanced each other to some extent, but it is hoped that the March figures will give perhaps a better indication of the situation.

New Naval Construction.

THE Navy Estimates for 1935, issued on Wednesday, March 6th, show a net total of £60,050,000, which exceeds the net total for 1934 by £3,500,000. Of this increase £245,196 is required to make normal progress with new construction; there is a rise of £166,200 in nine effective votes; an increase of £535,000 in the expenditure on the Air Fleet Arm, and a rise of £2,553,604 in the provision for the maintenance of the Fleet. The new construction programme for 1935 is as follows:—Three cruisers of the "Southampton" (late "Minotaur") type, one leader, and eight destroyers; three submarines, one a mine-layer, one a general service, or "P" type, and the other an "S" or patrol type vessel; one submarine depôt ship; four sloops; three minesweeping, and one convoy sloop; one surveying ship, and seven small vessels, including two coastal sloops, one small mine-layer, two gate vessels, and two trawlers. Dealing with engineering progress, it is stated that numerous modern developments in steam-raising plant are being kept under observation and utilised as far as possible. Trials and tests of various fuels and oil-burning apparatus continue, including burning tests of fuel oils produced from coal. At the Admiralty Engineering Laboratory, steady progress has been made in the development of high-speed oil engines, and increasing use is being made of fast-running, heavy-oil engines, both for boats and for auxiliary services on board H.M. ships. Both at home and abroad close touch is being kept with engineering developments, and arrangements have been concluded for several advanced designs to be made available for Admiralty investigation.

New Ships for Old.

THE Board of Trade has now made, with the consent of the Treasury, the necessary Order under Section 5 of the British Shipping (Assistance) Act, 1935, appointing Monday next, March 18th, as the date on which Part II of the Act shall come into force. Under this Part a total amount of £10,000,000 will be available for loan to British shipowners, to assist them in building new tonnage or in modernising the existing vessels of their fleet. The main conditions are that the vessels to be built must be of the same general type as those demolished, and that, in the case both of building and of modernising, the ships concerned must be of the general cargo-carrying type. To qualify for a loan to assist building the tonnage to be scrapped must be twice that to be built, and in the case of a loan for modernising, tonnage equal to that to be modernised must be scrapped. Facilities under this part of the Act will be available only for the period of two years from the date the Act was passed, February 26th, 1935. Full particulars of the scheme and the necessary forms of application for assistance are obtainable from the Mercantile Marine Department, Board of Trade, London, S.W.1.

The Late Mr. F. C. Coleman.

MANY of our readers will learn with deep regret of the death in Cape Town on Monday, March 11th, of Mr. Frederick Charles Coleman, the founder-editor and managing director of our contemporary *Modern Transport*. Mr. Coleman, who was only fifty-six years of age, was attending the fifth Imperial Press Conference in Africa as a delegate representing the British trade and technical Press. He had been ill some time before his voyage to South Africa, which he hoped would complete his convalescence. On reaching Cape Town, however, he had to go into a nursing home, and there he died. He was born in Norfolk on June 14th 1878, and was educated at the Queen Elizabeth Grammar School, Darlington. From 1894 to 1906 he served in the traffic department of the former London and North-Eastern Railway. Shortly after 1906 he entered the journalistic profession, and for many years he was one of our valued contributors, and also wrote many articles for trade and technical journals on such subjects as commerce, engineering, and railway, sea, and road transport. During the war he served as a transport officer, and acted in a liaison capacity with the Railway Executive Committee in connection with the recruitment and allocation of men drawn from British railways for military service. Later he was responsible for the organisation on a "war establishment" basis of the *personnel* at the Transportation and Train Ferry Depot at Richborough. In March, 1919, he was instrumental in founding *Modern Transport*, and it was due in no small measure to his enterprise and ability that that journal owes the position it has attained in the world of transport and of technical journalism.

New Naval Orders.

IT is announced by the Admiralty that, subject to the settlement of certain points of detail, it has decided to entrust the construction of the aircraft carrier of the 1934 naval programme, H.M.S. "Ark Royal," to Cammell, Laird and Co., Ltd., of Birkenhead. The name chosen for the new ship was that of the first aircraft carrier to be provided for the Royal Navy, apart from an adapted cruiser. That ship has now been renamed the "Pegasus," and is in reserve for catapult training and experiments. The new "Ark Royal" has been designed by Sir Arthur Johns, Director of Naval Construction. No details of her dimensions or cost have been published, but in the new Navy Estimates it is on record that the sum of £493,498 is to be spent on her up to March 31st, 1936. We may perhaps recall that there now only remain a surveying ship, the "Stork," and two small craft, the boom-working vessel "Dunnet," and the submarine school tender "Dwarf," to be ordered of the thirty vessels authorised in the 1934 programme. Contracts for these may be expected very shortly.

A Boiler Symposium.

THERE was a large attendance of members and friends on Tuesday evening, March 12th, at the Institute of Marine Engineers, when a series of short papers was presented on modern high-pressure marine water-tube boilers. They included original statements as to the most recent design and present position of the development of Atmos, Benson, La Mont, Loeffler, Sulzer, Velox, and Wagner-Bauer boilers, specially designed for marine use. In the paper presented by Dr. Goos, which was read by Dr. Queisser, of Berlin, some interesting particulars were given with regard to the four Siemens-Benson boilers which have been built by Blohm and Voss for the new turbo-electric Hamburg-American liner "Potsdam." The ship will be completed during the summer, and with her novel propelling machinery her trials will be looked forward to with considerable interest. In the paper on the Wagner-Bauer boiler, presented by Mr. Jebens, some further information was given concerning the design of the boilers for the new North German Lloyd turbo-electric liner "Scharnhorst," which is now under construction at the Deschimag yard, Bremen, and will enter the Far East service of her owners about June. In speaking on the Velox boiler Mr. M. G. S. Swallow stated that four such boilers were under construction for British and Continental naval departments. In the discussion which followed, some regret was expressed at the probable passing of the well-tried steam and water drum, but the general opinion seemed to be that, with the new tube materials now offered and the rapid development of welding in boiler engineering work, the time was ripe for new and simple designs, which would give larger outputs with smaller space and reduced attention.

An Engineers' Memorial Tablet.

ON Wednesday morning, March 13th, at 11.30 a.m., Mr. Freke Field, the first President of the Junior Institution of Engineers, unveiled at Lambeth North Underground Station a bronze tablet to mark the former site of the engine works of Maudslay, Sons, and Field. The inscription on the tablet reads as follows:—"On this site between 1810 and 1900 stood the works of Maudslay, Sons and Field, famous for marine and general engineering and as the training place of many engineers of renown. The Junior Institution of Engineers (Incorporated), founded in the Maudslay works, erected this tablet in its jubilee year, 1934." It may be recalled that in 1884 the Maudslay apprentices founded an engineering society under the presidency of Mr. Freke Field, who is a grandson of Mr. Maudslay's partner. That society still exists as the Junior Institution of Engineers, which appropriately completes its jubilee celebration by erecting and unveiling the tablet above referred to. Those of our readers who wish to gain some idea of the original Lambeth works of Maudslay, Sons and Field, and read an account of the many engineers of outstanding ability who received their training with the firm, would do well to consult the article by Mr. Foster Petree, which appeared in THE ENGINEER of June 8th, 1934.

The Channel Tunnel Scheme.

INTEREST in the proposed scheme for a Channel tunnel has again been revived in France by an address given at the Literary Union in Paris on Monday, March 11th, by Senator Yves le Trocquer, a former Government Minister. In his address, which was delivered before a crowded audience, Monsieur Trocquer stated that he considered that, whether viewed from the scientific, technical, economic, or financial points of view, the conditions for the successful solution of the problem presented by the construction of such a tunnel were at the present time remarkably favourable. He suggested that by using a new process by which the material excavated from the tunnel was discharged through the roof, it could be driven in about three years, and the cost of construction reduced from 3,500,000,000 francs, or £50,000,000 at current exchange rates, to 2,000,000,000 francs, or about £28,000,000. On the political and military sides, the insularity of Great Britain could, Monsieur Trocquer stated, no longer be evoked as an argument against the construction of such a tunnel. Even the British Government had, on one occasion, he continued, itself stated that Britain's frontier was now on the Rhine.

The Late Mr. John Gray.

WE regret to have to record the death on March 12th of Mr. John Gray, B.Sc., M.I.E.E., a director of the British Thomson-Houston Company, Ltd., and a well-known personality in the electrical industry. He was born on April 17th, 1874, and was educated at George Watson's College, Edinburgh, and at Glasgow University, where he took his B.Sc. degree in engineering. After serving as private secretary to Lord Kelvin, he joined the staff of Marks and Clerk, consulting engineers and patent agents, and was manager of the firm's Manchester office. In April, 1902, he joined the British Thomson-Houston Company, Ltd., and was placed in charge of the company's patent department; on October 12th, 1927, he was appointed to the board of directors. When the original British Broadcasting Company was formed in 1922, with the B.T.H. Company as one of the constituent firms, Mr. Gray was one of its directors. He was also a director of Calorizing Corporation of Great Britain, Ltd., and chairman of the Hotpoint Electrical Appliance Company, Ltd. For some time he was a member of the Council of the Chartered Institute of Patent Agents, and he was a valued member of the Institution of Electrical Engineers.

The Development of Parsons Industrial Turbo Machinery.

No. X.

(*Continued from page 244, March 8th.*)

SIDE-BY-SIDE GEARED TURBINE FOR COTTON MILL.

THE India cotton mill, of Messrs. Kershaw, Leese and Co., of Stockport, was, in the year 1913, typical of the larger and older cotton mills of the period. The mill itself was an eight-storey building, 100ft. high, in which ring spinning, mule spinning, and the requisite preparatory processes were carried on. The machinery was driven by a large slow-speed four-cylinder beam engine of about 2000 h.p., compounded on the McNaught principle, and working with steam at 120 lb. per square inch at the boilers. The fly-wheel of the engine geared with two pinions, each on its own second-motion shaft, and each of these shafts drove a vertical shaft extending to the top of the mill. Bevel gears on the vertical shafts drove the horizontal line shafts, generally two to each floor, running the whole length of the mill.

Owing to the age of the engine and gearing, serious defects were beginning to develop, and the installation of a new plant was decided on. Before the choice was made, the merits of all available types of prime movers were considered, and the question of driving the mill electrically by current either purchased from the supply authorities or generated on the premises was also examined. The conclusion finally reached was that a geared turbine transmitting its power by ropes to the various floors of the mill, as proposed by Messrs. Parsons, had such advantages in economy of operation, ease of installation, and smallness of space occupied, that it offered the most favourable solution of the problem.

The turbine supplied by Messrs. Parsons for the purpose was of an interesting type, as it consisted of a separate high-pressure and low-pressure cylinder arranged side by side. The machine had a normal capacity of 2300 b.h.p., but was capable of developing 2900 b.h.p. on overload. It worked with steam from the existing boilers, the pressure being 110 lb., and the temperature 494 deg. Fah. at the stop valve. Each of the turbine rotors was connected by a flexible coupling to its own pinion, the two pinions engaging with opposite sides of the main gear wheel. The gear ratio between each pinion and the low-speed gear wheel was 14 to 1, so that with each side of the turbine running at its normal speed of 3500 r.p.m. the low-speed shaft carrying the main rope driving pulley ran at a speed of 250 r.p.m. This pulley was 6ft. 4in. in diameter, and was grooved for forty-four 1·75in. ropes. The line shafts on the various floors were extended through the end wall of the mill, to project into a rope race constructed to house the drives from the main rope pulley.

The power of the turbine was developed about equally in each of the two cylinders of which it was composed. The overload of 2900 b.h.p. was obtained by a hand-operated by-pass valve contained in the main steam chest. This valve can be seen in the photograph of the plant reproduced in Fig. 91. Provision was made to enable either side of the turbine to be operated alone in case of necessity. To run the high-pressure side with the low-pressure cylinder out of action, a valve was fitted in the interconnection pipe, so that the high-pressure cylinder could exhaust to atmosphere when necessary. Alternatively, if it were desired to run the low-pressure cylinder alone, this could be done by means of a separate supply of live, non-superheated steam to that cylinder. This supply of steam was not under the control of the speed governor, as the turbine would only be running under these conditions in very exceptional cases; but for the sake of safety a combined run-away and stop valve was used to admit the steam, so that the machine would be shut down automatically in the case of overspeed.

The air pump and the circulating water pump were normally driven by a special group of six 1in. ropes from a pulley mounted on the coupling between the gear wheel shaft and the main driving shaft. In order that the turbine might have the benefit of a full vacuum at starting, however, the pumps could be driven independently by a small steam engine. As soon as the vacuum had been obtained, the turbine was run up to speed, and the attendant could then, by turning a single hand wheel operating a pair of friction clutches, simultaneously disconnect the pumps from the engine and cause them to be driven by the ropes above mentioned. The auxiliary engine could then be shut down at convenience.

The excellent starting torque of the turbine enabled it to put the whole mill in motion without difficulty against the heavy friction load to be overcome on Monday mornings after the week-end stoppages. There was, moreover, no need for a barring engine to facilitate the pulling on or overhauling of the ropes, for not only could ropes be put on by running the turbine round under its own steam, but the entire installation could be "inched round" for rope inspection or other purposes by suitable manipulation of the stop valve. This could not be done in the case of an ordinary reciprocating engine, which could only be moved round in the manner required, either by an auxiliary barring engine, or by the efforts of numerous men working with a heavy barring lever.

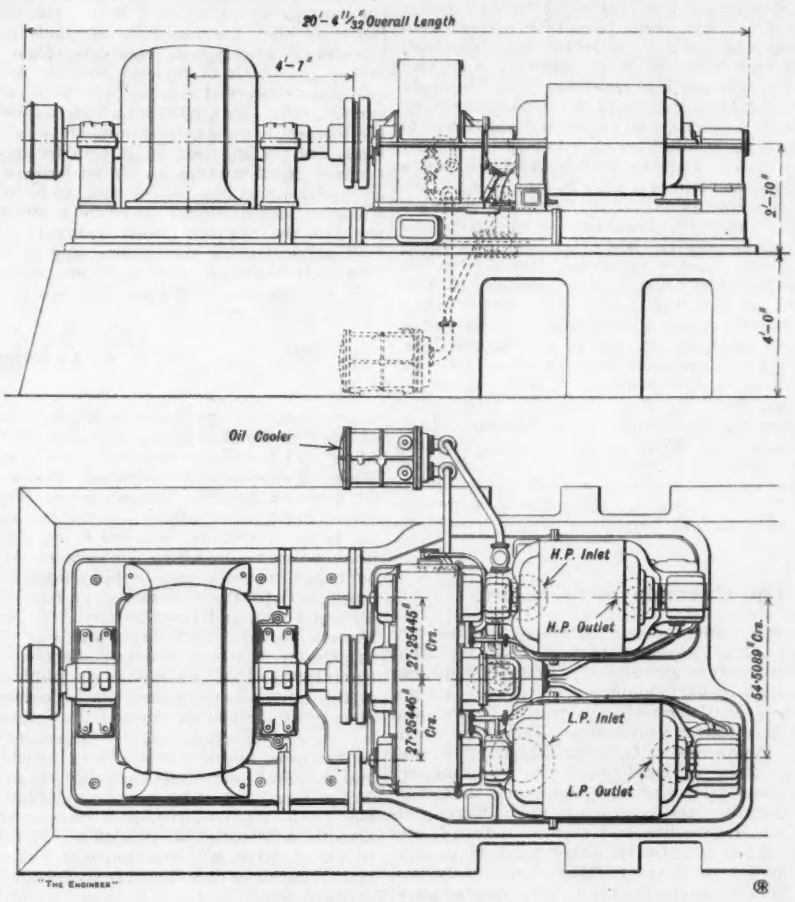


FIG. 92—MOTOR-DRIVEN SIDE-BY-SIDE CENTRIFUGAL AIR COMPRESSOR—1914

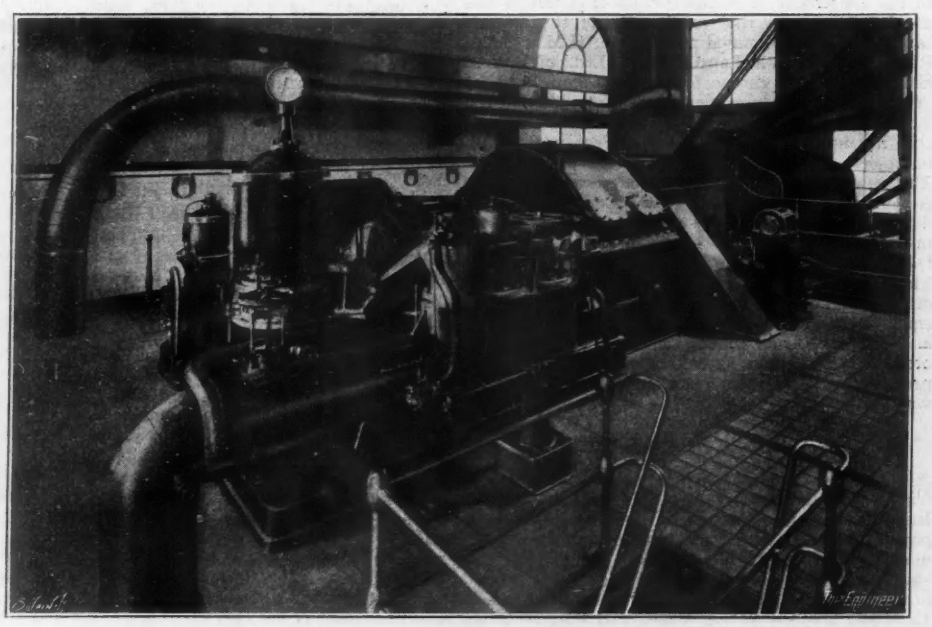


FIG. 91—2300 B.H.P. SIDE-BY-SIDE GEARED TURBINE—1913

MOTOR-DRIVEN GEARED-UP CENTRIFUGAL AIR COMPRESSOR.

The introduction of high-speed gearing was brought about by the desire to accommodate the high rotational speeds of steam turbines to the more moderate speeds necessary for the machinery that they were required to drive. All the earlier examples of Parsons mechanical gearing were therefore of the speed-reduction type. There was, however, no reason why gearing could not equally well be employed to raise the speed of the driven machinery, and an example of this practice was provided in 1914 by the construction of an air-compressing plant in which gearing was used to enable a motor running at 493 r.p.m. to drive a compressor at 6450 r.p.m. The machine in question was built by Messrs. Parsons to the order of the Champion Reef Gold Mining Company, Ltd., for service in India. The duty of the compressor was to deliver 3500 cubic feet of free air per minute at a gauge pressure of 60 lb. per square inch. The compressor was built in the form of a two-cylinder machine, with cylinders side by side, each driven by a pinion engaging with one side of a central gear wheel which was directly coupled to the electric motor. The general arrangement of the unit is illustrated in Fig. 92, while Fig. 93 shows its appearance under working conditions. The division of the compressor into two cylinders permitted a very compact lay-out to be attained, while the method of driving the rotors eliminated all side thrust from the central gear wheel. The two-cylinder design also resulted in shorter and, therefore, more rigid rotors, and afforded better facilities for the cooling of the

air. Each rotor comprised six centrifugal impellers, each 19·5in. in diameter, the rim speed of the impellers being, therefore, 550ft. per second at the normal rotational speed of 6450 r.p.m. The cylinders were water-cooled by the method already illustrated in Fig. 85 (*ante*) in connection with the description of the Pemberton Colliery machine, and additional cooling was provided by a separate external cooler through which the air had to pass on its way from the low-pressure to the high-pressure cylinder.

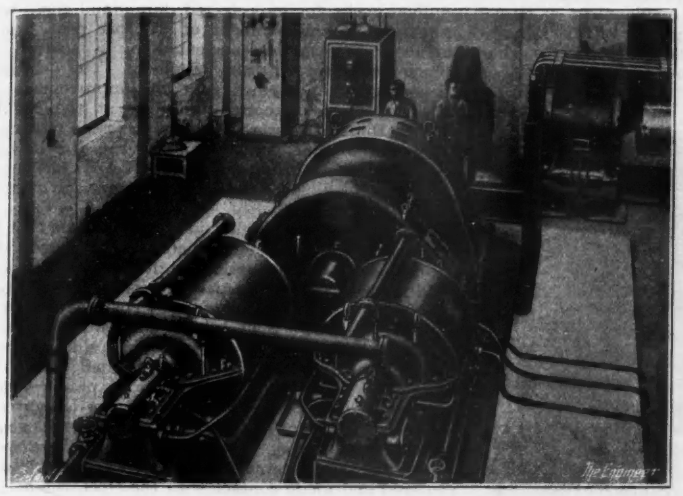


FIG. 93—MOTOR-DRIVEN AIR COMPRESSOR AT CHAMPION REEF GOLD MINE—1914

EXHAUST STEAM TURBINE WITH DOUBLE DRIVE.

The value of the power that could be recovered from the exhaust steam of a reciprocating engine led to the widespread adoption of exhaust steam turbines in combination with reciprocating plant, and many interesting mechanical problems therefore presented themselves for solution. Amongst these was that of employing an exhaust turbine to increase the power available for driving a steel wire rolling mill, owned by Guest, Keen and Nettlefolds, Ltd., at Rogerstone, Monmouthshire. The original plant consisted of a vertical compound condensing engine of about 2100 i.h.p. driving a group of eighteen wire mills, ranging from cogging mills down to the finishing mills for wire stock of 0·1875in. diameter. The wire rod was produced from the billets at a single heat. The power was transmitted by ropes from the engine fly-wheel to two main shafts running at different speeds. In 1916, more power being needed, an order was placed with Messrs. Parsons for an exhaust steam turbine to work in conjunction with the existing engine. The latter was altered so as to exhaust at atmospheric pressure, the steam then passing through an oil separator to the turbine, whence it was finally discharged into a condenser at a vacuum of 28·8in. Under these conditions the engine developed 1400 i.h.p. instead of the original 2100 i.h.p., but the turbine provided the equivalent of an additional 1600 i.h.p., thus increasing the total horse-power by about 43 per cent. for the consumption of the same quantity of live steam. In the event of the turbine being out of action, or its services not being required, the engine exhaust could pass directly from the oil separator into the turbine condenser, a pipe connection and sluice valve being provided for this purpose.

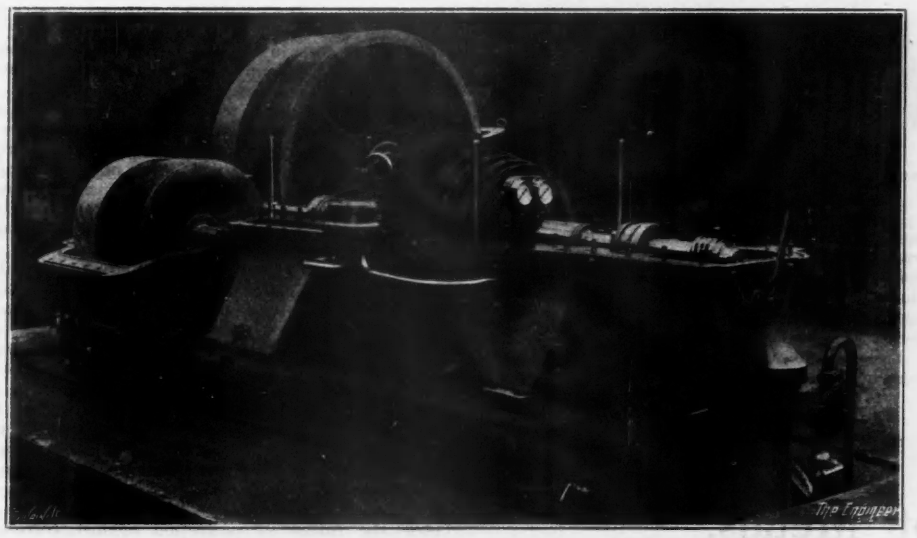


FIG. 94—TURBINE AND GEARING FOR STEEL WIRE ROLLING MILL—1916

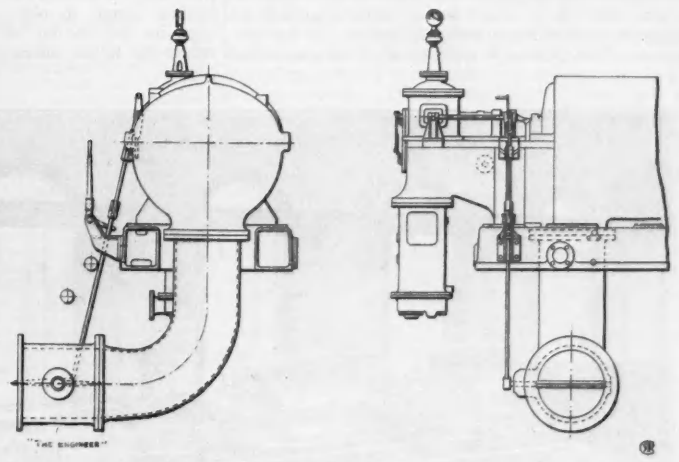


FIG. 96—RUNAWAY GOVERNOR GEAR

The arrangement of the turbine was particularly interesting. Its duty was to assist the engine in driving the two shafts already referred to, the speeds of which were 500 and 250 r.p.m. respectively. The method by which this was accomplished will be understood from the photograph reproduced in Fig. 94 showing the turbine and gearing with cover removed. The turbine ran at 3700 r.p.m. and drove a single pinion engaging with two gear wheels of different sizes, each of which drove one of the main shafts. These two shafts remained connected to the fly-wheel of the reciprocating engine by the original rope drives. The ropes, therefore, not only delivered the power of the engine to the mill, as before, but served also to equalise the load, transmitting power sometimes in one direction and sometimes in the other, according to which portion of the mill train was most heavily loaded at the time.

It will be noticed from the illustrations that the centres of the gear shafts were not in the same horizontal plane, the shaft carrying the large gear wheel being set considerably higher than the other, and the gear casing consequently being divided at an angle. This design was necessary on account of the relative positions of the shafts to which the gearing had to accommodate itself. The turbine, being mechanically connected with the reciprocating engine, and supplied only with steam coming from the latter, required no speed governor. It was, however, fitted with a runaway governor which shut it down in the event of overspeed by tripping a butterfly valve in the steam inlet pipe. Fig. 96 shows this arrangement. The centrifugal circulating pump in the basement was driven by ropes from the high-speed gear shaft, and the reciprocating air pump and lift pump were actuated by gearing from an extension of the spindle of the centrifugal pump.

TURBO-COMPRESSOR FOR THE ROTHERVALE COLLIERIES.

A considerable advance in the design of turbo-compressors was made in 1917, when a machine for a normal output of 10,000 cubic feet of free air per minute at a pressure of 100 lb. per square inch was built at Heaton for the Rothervale Collieries, Ltd., Rotherham. A section through this compressor is given in Fig. 95. It consisted of separate high-pressure and low-pressure cylinders with an external

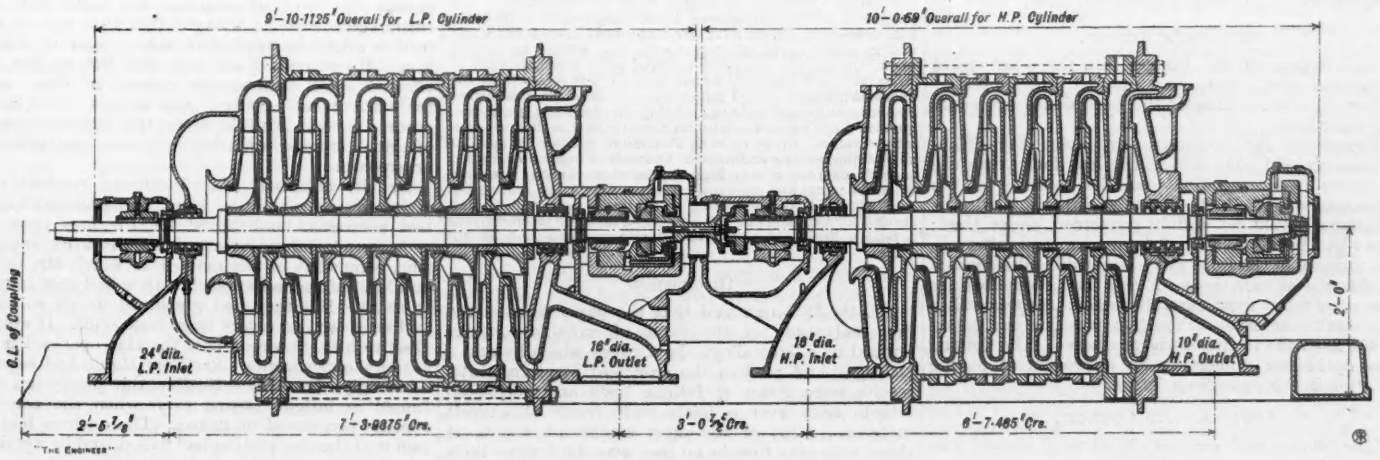


FIG. 95—SECTION THROUGH 10,000 CUBIC FOOT COMPRESSOR FOR ROTHERVALE COLLIERIES—1917

air cooler between them. Each cylinder contained six 30in. impellers, which ran with a peripheral speed of 590ft. per second when the machine was working at its normal rate of 4500 r.p.m.

Comparing the design with that of previous centrifugal air compressors, it will be noticed that the internal cooling arrangements have been improved by the provision of larger water chambers, while to facilitate erection the practice of bolting the various sections of the cylinder to each other by their adjacent tubular type. Such bearings, it will be remembered, comprised a number of loosely fitting concentric sleeves surrounding the central bush. Thin films of oil which were retained between the sleeves served to damp out vibrations and smooth running was therefore ensured at high speeds. Another feature that will be noticed is the employment of carbon-packed glands in place of glands of the labyrinth type for preventing air leakage along the shafts where the latter emerged from the cylinders.

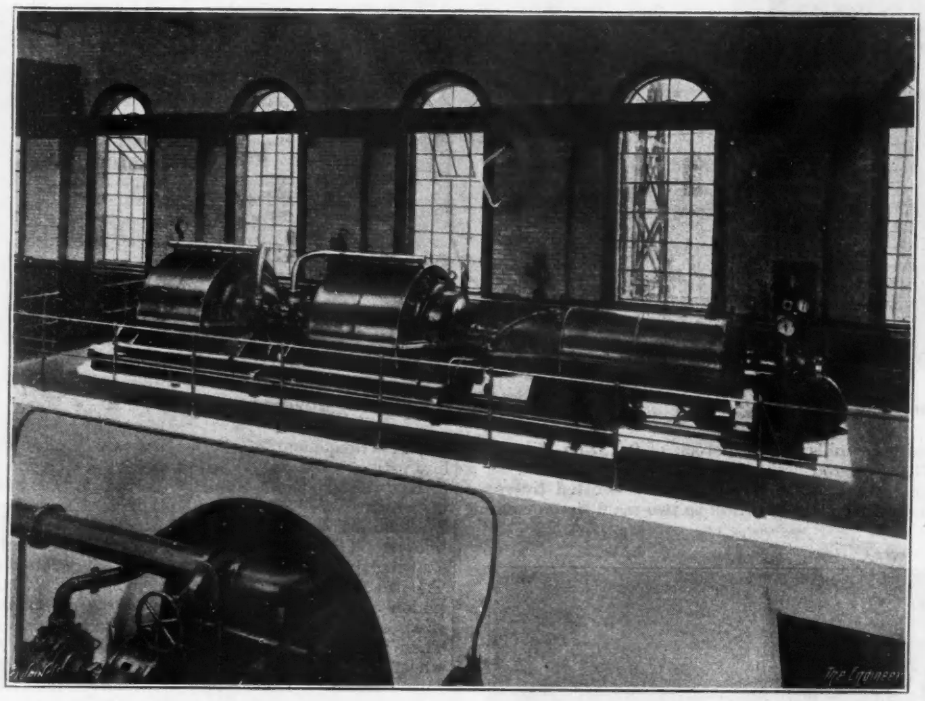


FIG. 97—10,000 CUBIC FOOT COMPRESSOR INSTALLED IN POWER-HOUSE

flanges was abandoned in favour of the principle of holding the whole assemblage together by longitudinal bolts running the full length of the cylinder. Another innovation in the design was the provision made for taking the end thrust of each rotor on a spherically seated thrust block instead of neutralising it by a dummy piston, as was previously done. The thrust collar of the low-pressure rotor was combined with the coupling sleeve, and both thrust collars had to be made easily removable as the bearings were of the

The steam turbine supplied for driving the compressor does not call for any detailed description. It was of the pure reaction type, containing forty-eight pairs of blade rows. It was designed to work with steam at a pressure of 160 lb. per square inch, superheated to 500 deg. Fah. and exhausted into a condenser at a vacuum of 28·3in.

Fig. 97 shows the appearance of the complete machine in the power-house at the colliery.

(To be continued.)

Institute of Metals.

No. I.

THE Institute of Metals held its twenty-seventh Annual General Meeting in London on Wednesday and Thursday, March 6th and 7th, in the lecture theatre of the Institution of Mechanical Engineers, Westminster. Dr. Harold Moore has been elected President for a second year—in accordance with a practice which has been followed for many years.

COUNCIL'S REPORT.

The Report of the Council for the year ended December 31st, 1934, was adopted, the President remarking that, as regards the work done, the report was satisfactory.

Presenting the accounts, Mr. John Fry (Hon. Treasurer) said that during the last four years the Institute had trespassed upon its reserves to the extent of about £1700. But he did not think the members should be unduly concerned about that; there had been a period of depression, and, after all, the purpose of the fund was to meet difficulties which might arise at such times. Every item of expenditure was scrutinised most carefully, and there was still a respectable reserve, although it was not the policy of the Institute to create a large reserve. The Council was optimistic concerning an improvement in the position in the immediate future.

OFFICERS AND COUNCIL.

The officers and members of Council elected this year were announced as follows:—

President, Dr. Harold Moore.

Vice-Presidents, Mr. R. Barclay, Dr. C. H. Desch, F.R.S.

Members of Council:—Lieut.-General Sir J. Ronald E. Charles, Engineer Vice-Admiral Sir Robert B. Dixon, Dr. R. Genders, A. H. Mundey, the Hon. R. M. Preston, and H. B. Weeks.

The reading and discussion of papers was then proceeded with.

The first paper taken for discussion was by Mr. Gerard and Mr. Sutton, on "Corrosion-fatigue Properties of Duralumin with and without Protective Coatings." The official summary was as follows:—

CORROSION-FATIGUE OF DURALUMIN.

Rotating cantilever endurance tests on Duralumin 3 L I (copper 4·1–4·4, manganese 0·64, magnesium 0·62–0·67, iron 0·84–0·81, silicon 0·22 per cent.) have been made in air and in a salt spray after protecting the surface in various ways. In air the untreated material gave a fatigue limit of stress of $\pm 9{\cdot}1$ tons per square inch at 10^7 cycles, and the anodised material $\pm 11{\cdot}1$ tons per square inch. In a salt-spray lanolin coating and cadmium-plating afforded little protection, but zinc-plating gave a substantial improvement in the corrosion-fatigue range. Spraying with aluminium was not so good as zinc-plating at long endurance. Coatings of organic resins and enamels afforded a very high degree of protection, especially when the metal had previously been anodised; the best results were obtained with a coating of synthetic resin varnish and stoving for two hours at 150 deg. Cent., metal so treated giving a fatigue limit stress of $\pm 12{\cdot}2$ tons per square inch at 10^7 cycles.

DISCUSSION.

Dr. H. J. Gough said that the paper marked the first real study of the value of metallic coatings applied to a light alloy. In a paper which he and a colleague had read to the Iron and Steel Institute, results were given of fatigue tests and corrosion-fatigue tests over a fairly wide range of aircraft materials. One of the most significant results of those tests was that in no case was the fatigue limit indicated under conditions similar to those used by Mr. Gerard and Mr. Sutton, and on close examination of their curves—for material with and without protection—the same broad conclusion became evident. A main lesson arising from their paper was that not a single one of the protective treatments or coatings used had afforded complete protection under the conditions of test applied—which admittedly were very severe. For that reason, he made a mild protest against the authors' use of the term "corrosion-fatigue limit"; the term "endurance limit" was much less misleading, was well recognised and meant something. There was no evidence of corrosion-fatigue limit in their results. Dr. Gough commented upon the remarkable improvements afforded by some of the coatings. Taking an endurance limit of 50 million cycles for unprotected duralumin, there was a maximum improvement of 277 per cent. when anodic treatment supplemented by a coating of pigmented varnish was applied. The electro-deposited zinc coatings gave an improvement of 231 per cent. Although the tests at the N.P.L. and at the R.A.E. were made on the same materials and in the same spray chamber, the N.P.L. had used two-point loading and the R.A.E. had used one-point loading. Yet the results agreed extremely well.

Professor B. P. Haigh said it was evident that in the authors' work the zinc had greatly delayed the occurrence of fatigue cracking, although the authors had recorded that it had given unmistakable evidence of flaking off during the tests. That was entirely in agreement with the results of some work in which he had shared during the war, when zinc coatings were used to protect steel wire. It had raised the endurance of the steel enormously in practice, and the results were entirely verified in the laboratory. The effect of galvanising the steel was almost as good, even if the coating were imperfect; if there were a hole in the galvanising, through which the water entered and made contact with the steel, the action did not appear to begin there. The mere presence of zinc, even if it did not cover the surface completely, was beneficial. From the theoretical point of view that was exceedingly significant.

Mr. U. R. Evans, who expressed general agreement with the authors' conclusions, said their tests were carried out under continuous-spray conditions, whereas the spraying to which the metals would almost certainly be subjected in service would be intermittent. The results of ordinary unstressed corrosion tests were quite different according to whether the spraying was continuous or intermittent. With intermittent spraying the corrosion products dried up and underwent changes, which might be beneficial or otherwise to the life of the metal. He was inclined to think that if one tested a number of materials, or the same material subjected to different protective treatments, the order of merit under continuous spraying might be distinctly different from the order of merit with intermittent spraying. Commenting upon the good protective results obtained with the synthetic resin preparation, he asked if it had a waterproofing action or whether there was something in it which inhibited the corrosion process. It was quite evident that zinc, which continued to protect even after it had begun to flake off, had an inhibitive effect, and it probably gave cathodic protection. It was likely, however, that the other varnishes simply waterproofed the metal. He supposed that in such cases the thickness of the protective coat was appreciable, which might mean that such protective processes would not be applicable to some products, as, for instance, screw threads, unless one made allowance for the thickness, even if the protective coating were hard enough. In his view the future of protection against corrosion-fatigue would not be based on materials which attempted to waterproof the metal, but on materials which would be applied very much more thinly, so that they did not sensibly alter the dimensions of the pieces to which they were applied, and which inhibited the corrosion process. One could treat iron screws in certain baths in such a way that nuts could still be threaded on them without difficulty, and yet the treatment afforded a certain element of protection. He did not say that process was good enough for practical purposes, but early work was encouraging, and he thought that that sort of protection might be applied to other materials besides iron. He welcomed the fact that the authors had effected some temperature control in their work, for without such control very serious errors might occur. It was possible to control the temperature of a small room to half a degree without great difficulty or expense.

Dr. R. Seligman (Past-President) recalled that, about fifteen years ago, when Williams and himself had proposed, he believed for the first time, the protection of aluminium and its alloys by applying zinc, somewhat in the manner in which Mr. Gerard and Mr. Sutton had applied it, they had been laughed to scorn. But they had continued to use it, and it had been used on a very large scale since. It was not clear to him, however, how the zinc operated in the authors' experiments. Professor Haigh had assumed—wrongly, he believed—that the protection continued in fatigue testing even when the zinc had become perforated or flaked. The authors had not said that the zinc plating had flaked, and he wondered whether it gave an electrolytic protection, as in commercial work, where there was no fatigue arising and where protection continued long after the coating had flaked.

Professor D. Hanson (Vice-President) asked if the authors considered that a true fatigue limit had yet been revealed in duralumin? With a coating of synthetic resin varnish, and stoving for two hours at 100 deg. Cent., the metal had given a fatigue limit stress of $\pm 12{\cdot}2$ tons per square inch at

10^7 cycles. That was very close to 50 per cent. of the range of the tensile and compression stresses, and he thought that we might be getting near to the real fatigue range of duralumin. But none of the curves revealed a true fatigue range, and it might be that the real fatigue figure, in the absence of any corrosion effect, was higher than $\pm 12 \cdot 2$ tons per square inch. He asked whether, if there were discontinuities in the protective coatings, the attack on the exposed regions would be accentuated, or whether the rate of attack would be normal, because in certain experiments the protection of a portion of a specimen during a corrosion-fatigue test led to rapid failure. If that occurred, it might have very serious practical consequences, and the matter ought to be tested before the work proceeded too far.

Dr. A. G. C. Gwyer (Vice-President), after commenting on the splendid results that had been obtained by the use of various types of protective coating, said he was not quite clear as to the exact effect of maintaining a continuous spray. Experiments with which he had been concerned, using the intermittent salt spray, on pure aluminium, confirmed the result shown by the authors, that great advantage was conferred by protection. It was not surprising that varnishes and enamel had shown up so well; one of the great advantages of anodised coatings was that they afforded a very powerful key for subsequent coatings, which latter became extraordinarily adherent. After asking whether the authors were likely to extend their work to conditions of temperature such as occurred in the tropics—for aeroplanes had to fly in the tropics—he said that the value of the paper from the industrial point of view was that it proved the great value of the treatments applied under conditions a great deal more strenuous than those commonly met with.

Dr. C. H. M. Jenkins asked if the authors had fully considered the effect of the metal base coating. They had used zinc-plated and cadmium-plated specimens. In iron and steelwork there had been considerable controversy as to the efficacy of electro-deposited zinc, and aluminium was much more likely than even steel to be sensitive to electrolysis. Had they considered pistol-spraying or Sherardising of cadmium? They had treated their specimens anodically and had obtained a very resistant film which probably did not absorb varnish particularly well; he asked if they regarded the anodic film as sufficiently porous to varnish, because a slightly more porous film might absorb varnish better and give better protection ultimately.

Dr. W. H. J. Vernon asked what was the efficiency of cadmium in affording protection against intercrystalline corrosion?

Dr. Burstall referred to waterproofing action, and asked if the authors considered that anodic treatment offered the same type of protection as a resin paint. He also asked if they had considered the advisability of destroying the coating before starting a test, and ascertaining whether the endurance limit of the material was the same when there was no coating applied at all.

Mr. Sutton, replying to Dr. Gough's reference to the shape of the curves, said that in all stages of the work the authors had borne in mind the importance of giving engineers the lowest possible values. Some of the results suggested that several samples had given low figures on account of peculiar local conditions; when such effects were of frequent occurrence they had to be taken into account, and the authors had thought it best to take the more pessimistic view and to give the engineer data on which he could rely. He agreed that the shape of the curves was of very considerable scientific interest. They would have liked to have extended the tests to much longer endurances, but they were restricted in material; there was apparently a limit to the amount of duralumin that could be obtained from one cast under definite working conditions. He agreed that caution was necessary in regard to the use of the term "fatigue limit" or "corrosion-fatigue limit" when there was no definite indication of a limit. Commenting on Professor Haigh's remarks, he said that zinc coatings did appear to delay breakdown, and the authors were of opinion that further improvement would be possible when we knew better how to apply zinc coatings to light metals. Cadmium coatings had flaked off during the tests, but zinc coatings had adhered fairly well, as judged by superficial examination by ordinary methods.

The authors did not know what would be the effect of intermittent spray as compared with substantially continuous spray. The synthetic resin they had used was free from pigment. They had tried to avoid the complications that arose when introducing trade descriptions of materials, but they would endeavour to give further help to those particularly interested in the use of pigments. Inhibition of corrosion was important, and the effect of anodic treatment seemed to be something more than just mechanical exclusion of something in contact with the surface.

Replying to Dr. Seligman, he said that zinc had adhered very well in the corrosion-fatigue tests; attempts to produce adherent coatings of zinc on aluminium-rich alloys had been very much more successful than with cadmium; although both zinc and cadmium could be electro-deposited very well on cast materials, they were not so easily made to adhere strongly to wrought materials.

He indicated that he would reply further to the discussion in writing.

Dr. H. J. Gough and Mr. D. G. Sopwith then submitted a paper, summarised below, on "Some Further Experiments on Atmospheric Action in Fatigue."

ATMOSPHERIC ACTION IN FATIGUE.

The paper describes experiments carried out to investigate further the effect of atmospheric environment on the fatigue resistance of metals. Previous experiments had shown that the substitution of a partial vacuum for the atmosphere led in some metals to a considerable improvement in the values of the fatigue limit determined, using cycles of reversed direct stress. Three suggestions have been offered as to the cause of this improvement, namely, (1) that oxygen is the primary factor, the presence of water (as a catalytic agent) also being necessary; (2) that atmospheric impurities, acid and alkaline, are responsible; and (3) that impurities, mainly gaseous, dissolved in the metal under test, react with the metal during fatigue.

To examine possibilities (1) and (2), fatigue tests have been made using copper and brass in four environments, namely, air, partial vacuum, also purified air (freed from acid and alkaline impurities), both in the dry and damp conditions. To examine possibility (3) fatigue tests, both in air and in a partial vacuum, have been made on a copper containing cuprous oxide, on oxygen-free copper, and also on copper deoxidised with phosphorus. As a matter of general interest, fatigue tests conducted both in the atmosphere and in a partial vacuum have been made on pure lead, also on Armco iron tested in two forms of heat treatment.

The results of the tests on copper and brass suggest strongly that the acid and alkaline impurities present in the atmosphere can have little, if any, influence on atmospheric corrosion fatigue, but that oxygen in the presence of water is probably primarily responsible. The results of the tests on the oxide-bearing and deoxidised coppers show that the comparative behaviour of these materials when tested in air and in a partial vacuum is unaffected by the different compositions of the dissolved gases present in the two materials.

DISCUSSION.

Professor D. Hanson (Vice-President) said that the paper seemed to offer the possibility of arriving at an understanding of the phenomena involved in determining the intrinsic strength of materials. The importance of water vapour and oxygen was clearly revealed, but the relative importance of the two was not properly sorted out. It would be interesting theoretically to have some further light thrown on the subject, and to know whether water vapour or oxygen was the more important, or whether one was vital and one was not, which was rather what the authors had suggested. He believed it was Dr. Gough's view that probably under the action of fatigue stresses the protective films which existed on all the common metals became broken and a fresh surface of the metal was exposed to the surroundings, and that the action could proceed because of the continual interruption of the film in that way. It was not always sufficiently appreciated how reactive the common metals were. Iron, zinc, aluminium, and many others existed in the form in which we knew them because they surrounded themselves with a protective layer. The freshly exposed metal was inherently reactive to water and to oxygen, and he saw no reason to suppose that the kind of effect discussed in the paper could not be caused by either one or other of those atmospheres. It might be possible to detect which had the preponderating action by looking for the generation of hydrogen as a reaction product. Possibly by fixing up a discharge tube in parallel with the vacuum chamber used by the authors and using discharge methods, some evidence on the point might be secured.

Discussing the reaction of the atmosphere on lead, Professor Hanson referred to a report by Dr. Greenwood, recently published in an Australian journal, showing that oxygen could penetrate into lead in solid solution. He doubted whether it would have much effect on the authors' conclusions. With regard to the investigation of the nature of the fracture in lead, which the authors had found rather difficult, owing to recrystallisation effects, Professor Hanson suggested that a temperature of 70 deg. in the setting compound was rather high, and even that temperature might have played an important part in the recrystallisation. The specimens might be mounted in dental amalgam, in which case it would be unnecessary to heat them when mounting.

Professor B. P. Haigh, after remarking that the work described carried metallurgists a long way forward, chiefly in the theoretical direction, in building a foundation for work which would blossom later, regretted that the authors had focussed attention so carefully on obtaining an almost perfect vacuum. He appreciated their object, but suggested that they might have done better if they had used perhaps a fewer number of stress ranges and had deliberately varied their vacuum. It would have been interesting to see whether, using air saturated with water vapour, the endurance varied systematically with air pressure. He hoped the paper did not represent the termination of the investigation. The catalytic action of water vapour required very careful investigation. In connection with a paper to the Institute seventeen years ago, when Jones and himself had first put forward evidence which seemed to point to atmospheric action, he had indicated that the appearance of the chemical action on the face of a fracture was often quite different from that on the external surface. He had recently examined some of the pieces used then, and the fractures produced with different reagents still showed in some cases a bluish green discolouration, whereas the external surfaces showed only brown. Perhaps it would be possible to say what different compounds were produced on the surfaces on which the stress acted, and on the external surfaces where the stress did not act.

Mr. H. Sutton asked if the authors had considered the use of air carefully dried, by including in the system a portion cooled by liquid air or something else at a very low temperature, in order to freeze out the moisture.

Dr. H. W. Brownsdon, who said he had supplied the authors with some of the coppers in the extruded condition, referred to occluded gases which might be present in them. The gases evolved by heating in a vacuum, which were very largely reaction gases, had very little relationship to the gases which might be physically occluded in the metal at normal temperatures, and deductions might be very misleading unless one differentiated between the two kinds of gases. It was difficult to understand why the different coppers had behaved so differently. There were subtle differences in the behaviour of coppers which differed only to the third place of decimals so far as impurity contents were concerned, and the reaction with moisture must be in some way related, not so much to the copper itself, as to some of the impurities which might be present.

Dr. W. H. J. Vernon said the authors had shown conclusively in the case of copper and brass, under the conditions of their experiments, that purification of the air was without appreciable influence upon the results. The onus was, therefore, thrown upon oxygen with its concomitant water vapour. It might be worth noting, however, that Teddington air, in which the tests were conducted, was relatively pure, and possibly in an industrial atmosphere, highly charged with impurities, some effect might be recorded. One would rather like to see the method extended to lead, in view of the special position occupied by this metal. In the tests with damp air, the authors had employed a relative humidity of 55 per cent. In his experience, however, that humidity was on the low side. The point might probably be of some importance, because in ordinary atmospheric corrosion there was almost invariably a critical humidity, and the results depended profoundly on whether the humidity fell below or rose above this critical value. The critical humidity nearly always occurred round about 65 per cent. He did not suggest that the critical humidity phenomenon would necessarily be as important in corrosion fatigue as in ordinary stressless corrosion, but the point should presumably be taken into account in future work in this field. A contemplation of the results impressed one with the complexity of the factors involved. The difficulty of correlation doubtless arose from chemical factors being superimposed upon mechanical factors. The authors had made it clear that chemical factors were associated essentially with the formation of oxide. But it was evident that there were two types of oxide formation at work. There was first the primary film of oxide on the metal surface—*i.e.*, prior to fatigue—which might or might not be protective. Secondly, the oxide formed during the process of fatigue itself, which was either neutral or definitely adverse, *i.e.*, it was never favourable. Possibly volume relationships of the oxides played a part in this state of affairs. For example, if one arranged the metals in the order in which they were affected by the exclusion of oxygen, lead headed the list by a substantial margin, whilst among the metals at the bottom of the list that were unaffected by access of oxygen there was the magnesium alloy, which would be expected to undergo an appreciable amount of oxidation whilst under test. Mechanical considerations apart, these two metals exhibited fundamentally different types of oxidation. The specific volume of oxide was apparently greater in lead and less in magnesium than the metal from which it was produced. Under static conditions, *i.e.*, as a superficial covering, the one film was protective and the other not; but under fatigue conditions it was conceivable that the positions might be reversed. The oxide having the greater specific volume, being produced on interior surfaces, might then have the greater tendency to assist in the failure of the material. This factor, even if tenable, was not the only one responsible for the results observed.

Dr. Gough, replying to the discussion, said the authors had some hesitation as to how far the work should go. It seemed to have reached a stage at which it became more of purely metallurgical interest than of engineering interest, and the authors were concerned more with the engineering side. He and Professor Haigh did not agree on this subject—and it was an extremely good thing that they did not. Haigh and Jones had stated in their earlier paper that corrosion fatigue occurred inside the specimen; but Dr. Gough did not believe a word of it. Haigh and Jones might be right, but, at any rate, he did not agree with them. Replying to Dr. Vernon, he said the authors seemed to have obtained some results which fitted the obvious explanation, and some which did not. In view of the authors' very careful oxidation experiments, their exceptions seemed to show that their work fitted in with the static corrosion work of Dr. Bengough and Dr. Vernon, whose contribution explaining the results in the paper was probably more important than the results themselves.

A paper by Dr. J. C. Hudson, entitled "The Effect

of Five Years' Atmospheric Exposure on the Breaking Load and the Electrical Resistance of Non-ferrous Wires," was then presented and is summarised officially as follows :—

ATMOSPHERIC CORROSION.

This paper gives the results of atmospheric corrosion tests in which various non-ferrous wires were exposed to an urban atmosphere for five years ; the extent of corrosion was measured both by determinations of the extent to which the breaking load of the wires had been decreased by exposure and by measurements of the increase in the electrical resistance of the wire. The results of the two series of tests are in reasonable agreement both with each other and with those of earlier tests. In general, the rate of corrosion observed was small, that of copper being, for instance, of the order of 0·0002in. per annum ; the rate was definitely higher for nickel, nickel-copper alloys with high nickel contents, zinc, and brass, the breaking load of the last material being appreciably impaired by the effects of "copper redeposition." The most corroded material of all was a galvanised iron wire, which failed rapidly when the zinc coating had corroded. Comparison of the present results with those of similar tests over shorter periods points to the conclusion that in many cases, such as those of copper and high-copper bearing alloys, the rate of corrosion decreases with time of exposure.

DISCUSSION.

Dr. W. H. J. Vernon thought the specimen used was important. It was gratifying that the conclusions reached in the two years' tests were largely confirmed by the results of the five years' tests. Apart from the anomalous behaviour of the brasses, as shown by the tensile test, there was a satisfactory agreement between the results of the tensile and the electrical testing methods.

Mr. U. R. Evans, expressing his agreement with the conclusions arrived at, said that if a corrosionist had nothing to say about a paper on corrosion he should say it with emphasis, for it meant that he accepted it—and it was very important to obtain for their agreements the same degree of publicity as for their disagreements. A great number of people were working very hard on corrosion problems, expending much mental and physical effort, and recording their results at the expense of the taxpayer, or of some other group of benefactors, in order that the results should be studied and applied. But these published results were not read to the extent that one would hope, and he believed that that was very largely due to the idea having got about that no two corrosionists ever agreed, and that any paper on corrosion expressed merely the opinion of the author and nobody else.

Dr. Hudson, replying to the discussion, said that in average circumstances the rate of corrosion of zinc could be regarded as being about fifteen times less than that of iron. But there were exceptional circumstances ; in railway tunnels, for instance, zinc corroded more rapidly than iron on account of humidity. It seemed that in most cases one might assume that the rate of corrosion would not increase with time.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PRIVATE ELECTRIC PLANT *v.* PUBLIC SUPPLY.

SIR,—I have read with interest your leader on the subject of Mr. J. S. Sumner's paper "Private Plants and Public Supply Authorities," read before the Institution of Electrical Engineers on February 28th, in which you remark on the very mild discussion which it seems to have brought forth.

It is only human nature to be somewhat biassed in the direction in which one's interests lie and possibly the reason for Mr. Sumner's paper having no strong criticism from the point of view of private plants is that the majority of his listeners, being members of the Institution of Electrical Engineers, are, on the whole, perhaps more interested in the development of the grid than they are in private power plants.

It is quite possible that on such an occasion oil engine builders, for instance, may not have been represented at all.

In supplying costs to prospective customers of generating their own current, naturally capital charges and upkeep must always be taken into account, and my experience is that most, if not all, manufacturers allow for these on a liberal basis which could be relied upon to conform with actual practice.

In many cases oil engine builders can, without difficulty, produce figures for rural areas which are beyond criticism, and which conclusively prove that private power plant can supply current at a lower figure than can usually be obtained from the public supply, though, as you point out, conditions vary in different areas.

As far as industrial areas are concerned, when the question of pass-out or back-pressure turbines is involved, I know of one case, for instance, in which a pass-out turbine, after making due allowance for depreciation, maintenance, &c., shows a saving to its owners of £7000 a year over the cost of current from the public supply when this was furnished at approximately 0·32d. per unit, and in order to compete with the private plant it would have been necessary for the bulk supply to come down to a rate of under one farthing per unit.

The saving in question was secured by a total capital expenditure of approximately £30,000, so that it will be seen that the return on the outlay was very liberal. Had the concern in question had up-to-date boilers when the pass-out turbine plant was installed, the return would have been very much greater, as most of the savings in running cost were due to the installation of turbine plant, and most of the outlay was on boiler plant, the turbine portion only representing between £5000 and £6000.

This is by no means an isolated case, and where pure back-pressure turbines can be used the cost of current comes down practically to depreciation, maintenance, and attendance charges only.

G. A. NEILD.

Bedford, March 9th.

CAUSTIC EMBRITTLEMENT.

SIR,—The few paragraphs on caustic embrittlement in the excellent paper on "Care of Modern Steam Generating Plant," by R. J. Glinn, in your recent issue of February 1st, are of considerable value and interest.

There is another point of view regarding caustic embrittlement fractures not usually recognised. It is, to be sure, referred to in Schuster's paper, but perhaps merits more emphasis than has been given to it.

It appears to be a fact that wherever caustic embrittlement occurs the metal in the immediate vicinity of the cracking shows the effects of overstrain. Such can be shown by Fry's etching process. This renders visible those regions in the metal which have suffered by the slip process that forms the basis of plastic strain in metals. When holes are punched in steel plates the metal in the neighbourhood of these holes may be severely overstrained. This phenomenon is well known and is discussed in detail by Nadai in his "Plasticity." The driving of rivets often adds to the overstraining effect.

In addition to the above, it is a well-known fact that mild steel which has suffered plastic strain is thereby rendered more susceptible to corrosion. Layers of material, sometimes containing many crystal grains, are involved in the slip process, from a macroscopic point of view. The corrosion is transcrysalline, as well as intercrystalline, in character, penetrating the grains along the slip layers, and it may well exert a disrupting as well as a weakening effect.

In cases of stress concentration due to holes in plates, the three-dimensional character of the stress may be such as to produce relatively small shearing stresses as compared with the tensile stresses in the same region. When the tear resistance is lowered by corrosion, tearing sets in before there has been a chance for the shearing stresses to rise high enough to cause plastic strain and the phenomenon of embrittlement makes its appearance ; that is to say, fracture takes place without prior plastic strain, and for this reason one would not expect to find Fry's etching figures if the corrosion be due to attack upon the grain boundaries when the latter are subjected to stress. The presence of overstrain, as disclosed by Fry's method, does not point to overstrain in service, but rather to an overstrain during fabrication.

It would be interesting to see if caustic embrittlement could be induced in test specimens, under tension stress, which, after being punched and reamed, were subjected to a suitable annealing treatment—above the critical range—so as to obtain a recrystallisation, thereby eliminating, for the most part at least, the effects of pro-service overstrain.

I. F. MORRISON,
Professor of Applied Mechanics.

University of Alberta,
February 22nd.

High-Speed Railway Runs.

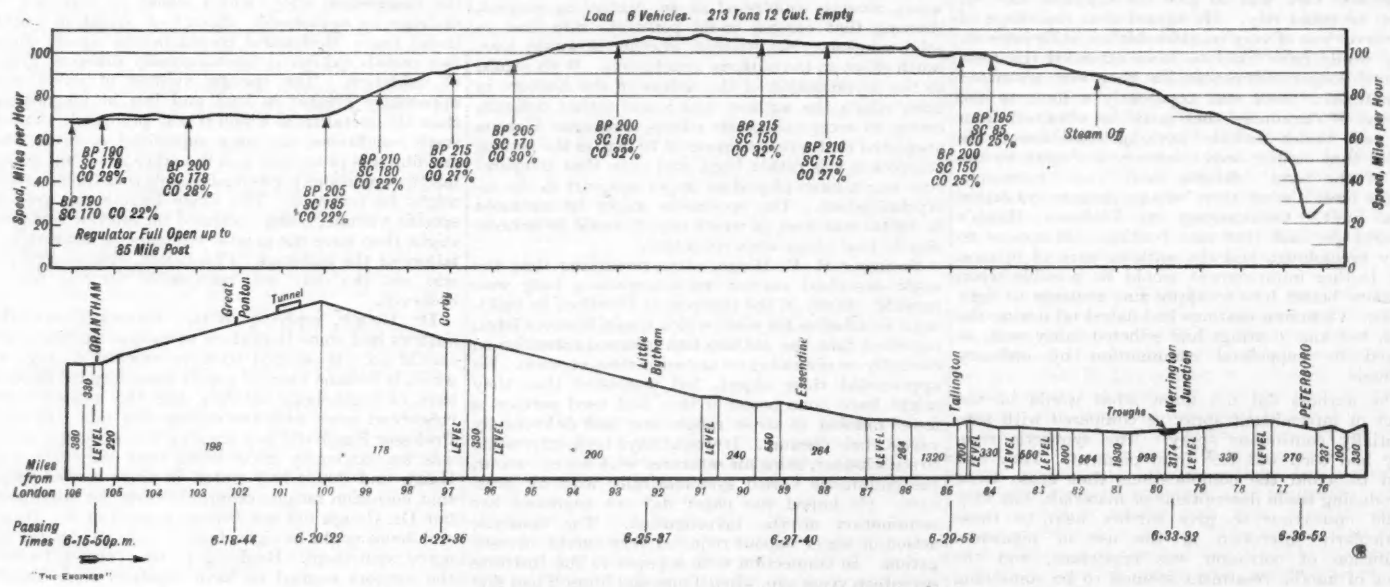
AS briefly recorded in our "Journal" last week, two remarkable runs between London and Newcastle were made by a L. and N.E.R. train on March 5th. We are now able to give further particulars, technical details, and tables of the double trip.

The engine, No. 2750, "Papyrus," was built in the Doncaster Works of the company in 1928, and has since run 392,853 miles. It left Doncaster Works after a general repair on January 19th, 1935, and up to March 4th, 1935, had run 7719 miles. It is in all respects standard and of the same class which made the record London-Leeds runs on November 30th last—see THE ENGINEER, December 14th, 1934. It is one of the engines used on the non-stop "Flying Scotsman." It has three cylinders, 19½in. diameter, 26in. stroke, and its boiler pressure is 220 lb. per square inch. The diameter of the blast pipe top is 5½in. The 8in. piston valves fitted are the standard type of solid head valve with four narrow rings, with ring control. The valve stroke is 5½in. at 65 per cent. cut-off.

The formation and weight of the train was as follows :—

	T.	C.	T.	C.	
Engine and tender	158	13	158	13	working order
Dynamometer car	32	17			
Corridor, First, No. 1131	35	7			
First diner, No. 43,041	43	17			
First, No. 4231	33	7			
First, No. 441	34	15			
First brake, No. 43,177	33	9			
			213	12	
Total weight, engine and train			372	5	

No attempt was made to exceed the booked timing on the down journey, but about 2 miles north of Doncaster, owing to the derailment of some wagons which had occurred earlier in the morning, a severe signal check was experienced and the train was actually stopped for 24 seconds. The train was 1¼ minutes late at York, but Darlington was passed three minutes ahead of time and the arrival time at Newcastle was anticipated by 2 min. 22 sec.



DYNAMOMETER RECORD OF SPEED AND PROFILE OF TRACK FROM GRANTHAM TO PETERBOROUGH

HIGH-SPEED RAILWAY RUNS

King's Cross to Newcastle, March 5th, 1935. Engine No. 2750. Vehicles, 6. Load, 210 Tons.

Miles from King's Cross.	Station.	Times. Booked. h. m.	Times. Actual. h. m. s.	Speed, m.p.h. Passing.	Speed, m.p.h. Average between booking points.	Speed, m.p.h. Maximum attained between booking points.
—	King's Cross	9 8	9 8 28			
2·51	Finsbury Park		9 13 12	52		
3·4	Harringay		9 14 13	58½		
4·05	Hornsey		9 14 50	67		
5·0	Wood Green		9 15 35	72		
6·43	New Southgate		9 16 49	72		
8·37	Oakleigh Park		9 18 28	71½		
9·15	New Barnet		9 19 7	72½	58·8	76
10·58	Hadley Wood		9 20 16	73½		
12·72	Potters Bar		9 22 8	64½		
14·64	Brookmans Park		9 23 45	67½		
17·68	*Hatfield*	9 27	9 26 32	76		
20·31	Welwyn Garden City		9 28 33	72½		
22·0	Welwyn		9 29 58	72	76·2	84
25·03	Knebworth		9 32 34	76½		
28·57	Stevenage		9 35 15	76½		
31·92	*Hitchin*	9 38	9 37 45	84		
35·7	Three Counties		9 40 22	86½		
37·04	Arlesey		9 41 20	87½		
41·15	Biggleswade		9 44 14	85		
44·12	Sandy		9 46 19	82	82·8	88
47·51	Tempsford		9 48 42	85		
51·73	St. Neots		9 51 45	81		
55·95	Offord		9 54 53	68		
58·87	*Huntingdon North*	9 58	9 57 17	77½		
63·52	Abbots Ripton		10 0 52	78½	72·6	87
69·36	Holme		10 5 6	78½		
72·60	Yaxley		10 7 41	71		
76·36	*Peterborough North*	10 14	10 11 44	20½		
84·84	Tallington		10 19 46	81		
88·64	Essendine		10 22 47	77		
92·22	Little Bytham		10 25 33	78	71·6	81
97·1	Corby		10 29 24	77½		
102·04	Great Ponton		10 33 20	76		
105·45	*Grantham*	10 40	10 36 7	67½		
109·68	Barkston		10 39 42	79		
111·53	Hougham		10 41 5	79½	76·1	84½
115·37	Claypole		10 44 0	80½		
120·1	*Newark*	10 51	10 47 40	71		
126·39	Carlton		10 52 51	76½		
127·38	Crow Park		10 53 38	75	69	76½
131·25	Dukeries Junction		10 57 0	61		
131·9	Tuxford		10 57 38	61		
138·62	*Retford*	11 7	11 3 45	58		
141·73	Sutton		11 6 46	69½		
143·95	Ranskill		11 8 38	73	62·9	81½
145·81	Scrooby		11 10 8	74½		
147·70	Bawtry		11 11 40	72½		
151·31	Rossington		11 14 43	78		
155·96	*Doncaster*	11 21	11 20 20	5		
155·96	*Doncaster**	11 21	11 20 20	5		
158·06	Arksey		11 26 55	28½		
163·00	Moss		11 31 48	78		
165·96	Balne		11 33 59	83½	55·6	87
167·22	Heck		11 34 55	84		
169·76	Temple Hirst		11 36 44	85		
174·31	*Selby*	11 38	11 40 33	38		
178·49	Hiccall		11 44 45	74½	64	82½
181·10	Escrick		11 46 48	78½		
183·95	Naburn		11 48 55	81½		
188·14	*York*	11 52	11 53 30	23½		
193·68	Beningbrough		11 59 7	79	69	83
197·88	Tollerton		12 2 12	82		
199·31	*Alne*	12 3	12 3 13	82		
201·49	Raskelf		12 4 48	81	81·7	84½
204·21	Pilmoor		12 6 50	80		
206·14	Sessay		12 8 17	80		
210·34	*Thirsk*	12 13	12 11 18	84½	80·9	87
214·64	Otterington		12 14 23	82		
218·09	*Northallerton*	12 19	12 17 3	78½		
221·87	Danby Wiske		12 19 53	81	75·7	82½
225·34	Cowton		12 22 26	79½		
229·66	Croft Spa		12 25 56	68½		
232·26	*Darlington*	12 31	12 28 16	67		
237·68	Aycliffe		12 33 6	59½	68·4	74
242·34	Bradbury		12 37 8	72		
245·10	*Ferryhill*	12 43	12 39 32	66½		
250·00	Croxdale		12 44 3	64	54·7	68½
254·22	*Durham*	12 53	12 49 32	33		
258·14	Plawsworth		12 53 53	66		
260·00	Chester-le-Street		12 55 30	75	62	75
262·82	*Birtley*	1 1	12 57 52	70½		
264·46	Lamesley		12 59 23	52	42·2	70½
265·70	Low Fell		1 0 55	49½		
267·04	Bensham		1 2 28	50		
268·28	*Newcastle*	1 8	1 5 38			

* 24 sec. stop before Arksey and signal checks. Average speed throughout 68 m.p.h.

Newcastle to King's Cross, March 5th, 1935. Engine No. 2750. Vehicles, 6. Load, 210 Tons.

Miles from Newcastle.	Station.	Times. Booked. h. m.	Times. Actual. h. m. s.	Speed, m.p.h. Passing.	Speed, m.p.h. Average between booking points.	Speed, m.p.h. Maximum attained between booking points.
—	*Newcastle*	3 47	3 47 10			
1·24	Bensham		3 50 42	47½		
2·58	Low Fell		3 52 10	57	39·4	59
3·81	Lamesley		3 53 45	52		
5·46	*Birtley*	3 55	3 55 29	50		
8·27	Chester-le-Street		3 58 10	68		
10·15	Plawsworth		4 0 25	35	52·2	68
14·05	*Durham*	4 4	4 5 22	32		
18·27	Croxdale		4 10 35	51½	55	72½
23·17	*Ferryhill*	4 13½	4 15 20	72½		
25·94	Bradbury		4 17 30	81		
30·60	Aycliffe		4 21 12	63	72·2	84
36·01	*Darlington*	4 25½	4 26 0	70½		
38·61	Croft Spa		4 28 5	81½		
42·94	Cowton		4 31 15	83½	82·2	87
46·41	Danby Wiske		4 33 40	87		
50·18	*Northallerton*	4 37½	4 36 20	81½		
53·64	Otterington		4 38 58	82	81·4	82½
57·94	*Thirsk*	4 43½	4 42 3	82		
62·14	Sessay		4 45 5	84½		
64·06	Pilmoor		4 46 27	88	84·4	88
66·79	Raskelf		4 48 20	86		
68·96	*Alne*	4 52	4 49 52	83		
70·40	Tollerton		4 50 53	83	71·1	83
74·60	Beningbrough		4 53 55	82		
80·14	*York*	5 2½	4 59 18	19½		
84·33	Naburn		5 5 0	65		
87·16	Escrick		5 7 26	75	57·6	76
89·79	Riccall		5 9 32	73		
93·96	*Selby*	5 16	5 13 43	31½		
98·51	Temple Hirst		5 18 23	72½		
101·05	Heck		5 20 28	75½		
102·31	Balne		5 21 28	79	54·8	79
105·29	Moss		5 23 47	74		
110·21	Arksey*		5 30 21	16		
112·31	*Doncaster*	5 34	5 33 47	53		
112·31	*Doncaster*	5 34	5 33 47	53		
116·89	Rossington		5 37 48	75		
120·58	Bawtry		5 40 40	82		
122·46	Scrooby		5 42 3	83	75·6	85½
124·33	Ranskill		5 43 23	83½		
126·54	Sutton		5 45 0	78½		
129·66	*Retford*	5 49	5 47 32	67		
136·37	Tuxford		5 53 33	72½		
137·02	Dukeries Junction		5 54 5	73		
140·90	Crow Park		5 57 9	72½	70·9	77
141·89	Carlton-on-Trent		5 57 57	72		
148·16	*Newark*	6 4	6 3 0	77		
152·90	Claypole		6 6 43	73		
156·74	Hougham		6 10 0	66½	69·5	77½
158·60	Barkston		6 11 43	60½		
162·82	*Grantham*	6 16	6 15 50	68½		
166·23	Great Ponton		6 18 44	70½		
171·18	Corby		6 22 36	91		
176·05	Little Bytham		6 25 37	105½	83·2	108
179·63	Essendine		6 27 40	102		
183·44	Tallington		6 29 58	98		
191·92	*Peterborough*	6 42	6 36 52	22		
195·67	Yaxley		6 41 28	72		
198·97	Holme		6 43 55	80½	68·6	82½
204·76	Abbots Ripton		6 48 20	72		
209·40	*Huntingdon North*	6 58	6 52 10	75		
212·32	Offord		6 54 40	70½		
216·55	St. Neots		6 58 3	75½		
220·76	Tempsford		7 1 10	86		
224·15	Sandy		7 3 32	83½	79·8	87
227·12	Biggleswade		7 5 39	84		
231·24	Arlesey		7 8 38	83		
233·58	Three Counties		7 9 38	82		
236·36	*Hitchin*	7 19	7 12 26	78		
239·71	Stevenage		7 15 2	78	77·2	84
243·24	Knebworth		7 17 44			
246·28	Welwyn		7 20 15	75		
247·96	Welwyn Garden City		7 21 35	77		
250·60	*Hatfield*	7 30	7 23 30	80		
253·64	Brookmans Park		7 26 0	78		
255·56	Potters Bar		7 27 21	76		
257·70	Hadley Wood		7 29 0	81		
259·13	New Barnet		7 30 0	83		
259·91	Oakleigh Park		7 30 35	84	68·6	84
261·85	New Southgate		7 32 0	81		
263·30	Wood Green		7 33 4	80½		
264·23	Hornsey		7 33 46	74½		
264·88	Harringay		7 34 20	67		
265·77	Finsbury Park		7 35 5	64		
268·28	*King's Cross*	7 47	7 38 58			

Average speed, Newcastle—King's Cross, 69·6 m.p.h. * Check at Arksey.

The average speed from King's Cross to Newcastle, including the delay near Doncaster, was 68 m.p.h. The return trip was worked by the same engine, but with a fresh set of men. On the section from Grantham to Peterborough the driver was given an opportunity of showing what the engine could do, and the booked times were considerably improved on. It was on this section that the fastest speed which has so far been recorded in Great Britain was attained. The train passed Grantham at 68½ m.p.h., and this speed was maintained up 5 miles of 1 in 198, the speed at the top of the hill being 70 m.p.h. at the 100 mile post. From this point the speed steadily increased on the down gradients of 1 in 178 and 1 in 200 to a maximum of 108 m.p.h. For a distance of 12·3 miles between Corby and Tallington the time taken was 7 min. 20 sec., giving an average speed of 100·6 m.p.h. The dynamometer chart shows this performance in graphical form, together with the gradient section. The train having arrived at Peterborough five minutes ahead of time, no further attempt was made for spectacular running between Peterborough and London, but King's Cross was reached eight minutes before the booked time.

The coal was a South Yorkshire and the consumption was as follows :—

	Tons cwt.
Coal issued at King's Cross prior to working down trip	9 5
Coal issued at Gateshead prior to working return trip	5 0
	14 5
Coal remaining on tender when the engine returned to King's Cross	3 10
Consumption, King's Cross to Newcastle and back, 536 miles	10 15

This gives an actual consumption of 44·93 lb. per mile, including lighting up.

The engine, when running at 108 m.p.h., was worked at 32 per cent. cut-off with regulator full open, and at this speed the 6ft. 8in. driving wheels were making 453 r.p.m. and the piston speed was 1965ft. per minute.

In order to meet the familiar difficulty of getting the steam out of the cylinders at high speed, Mr. Gresley, when designing the "Pacific" type of engine, gave special consideration to the provision of a direct streamlined flow for the exhaust from the cylinders to the blast pipe nozzle. Consequently it was possible to run at a speed of over 100 m.p.h. with a cut-off so late as 32 per cent. without the exhaust being choked in any way. It is also notable that the piston valves have only a diameter of 8in., which is generally regarded as small for 19in. cylinders, but this did not detract from the free running.

The speed record in the dynamometer car is obtained by means of two-second time intervals, marked on a paper roll travelling at 1ft. to the mile. The speeds were ascertained at ten-second intervals and plotted on the chart.

A PRELIMINARY notice has been issued stating that an Empire Exhibition is to be held in Johannesburg at the end of 1936. The undertaking has the approval and financial support of the Government of the Union of South Africa and of the City of Johannesburg. Invitations to participate have been sent to the various Governments of the British Commonwealth and commercial exhibits from all parts of the Empire will be accepted. The London office of the Exhibition is at 21, Tothill-street, S.W.1.

Leipzig Technical Fair.

No. II.

(*Continued from page 248, March 8th*).

IN last week's article we referred principally to some of the very large machine tools, which, after an absence of some years, were, this year, again a feature of the exhibits in Hall No. 9 of the Leipzig Technical Fair. We now pass to the more general range of machine tools, among which we noted several machines exhibited in London at the Fifth Machine Tool and Machinery Exhibition in November last. Beside the more popular machines we saw not a few

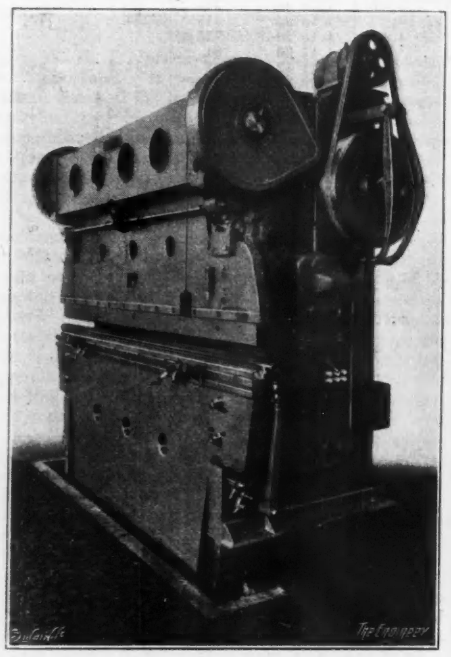


FIG. 9—FOLDING PRESS—SONNTAG

new designs of presses and shears, and of such tools as lathes, drills, milling, shaping, planing, and grinding machines, which were alike noteworthy for high speeds and new construction. From these exhibits we have chosen at random some few examples which we think may be of interest to our readers.

R. SONNTAG.

In Fig. 9 we illustrate a folding and bending press which was shown by R. Sonntag G.m.b.H., of Gera-

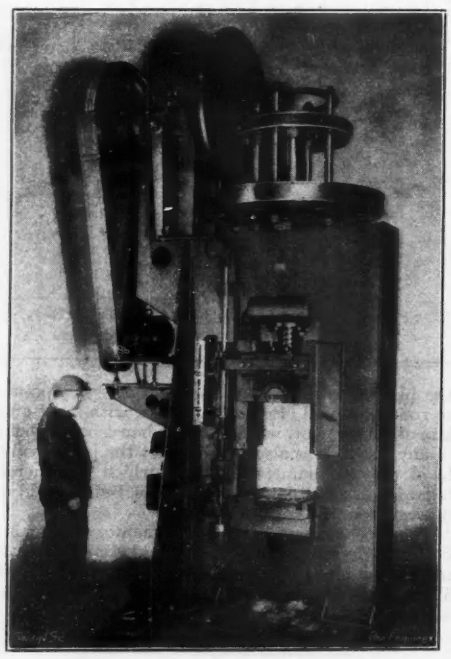


FIG. 10—FRICTION SCREW PRESS—PELS

Zwötzen. This 125-ton press has a length of 4 m., with a working stroke of 80 mm. The bed, side columns, bridge piece, and the ram are all built up of steel plates, electrically welded together, and as a whole form a closed framework of exceedingly strong construction. The bed or table is supported at its ends on crescent-shaped bearings, which, it is claimed, distribute the working pressure equally over the two columns. There are two driving excentrics, one at each side of the ram, and the drive is by vee belt from an 8 to 10 b.h.p. motor through a combined cone and plate-type clutch, which is operated through an electric control mechanism by the press lever. The mechanism is so constructed that the working stroke can be easily adjusted to suit different operations. All working parts are automatically lubricated from a chain-driven lubricator placed at the back of the machine. A special feature of the table or bed arrangement is the provision of an adjustable guide bar—for tapered work—which can be quickly set to the desired angle by steel tape indicators placed towards either end of the bed. An automatic depth indicator is also provided. The work we saw turned out by the press was clean and sharp angled, and seemed to bear out the claims for the improvements which have been, as the result of past experience, embodied in the new design. By the addition of certain devices the press we have described can be quickly adapted for multiple punching and sheet shearing work.

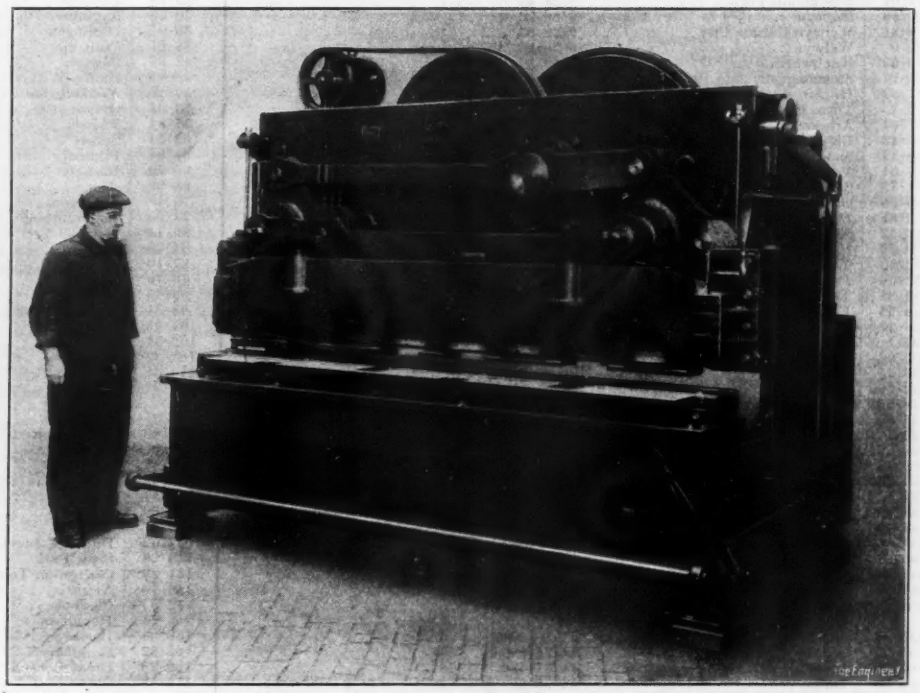


FIG. 11—GUILLOTINE SHEARS—PELS

HENRY PELS AND CO.

On the stand of Henry Pels and Co. A.G., of Berlin, Erfurt, and London, considerable interest was shown in the vertical friction screw press, illustrated in Fig. 10. This machine is a 140-ton press, with a spindle diameter of 145 mm., or nearly 5¾in. The body is built up of welded steel plates, with the driving motor placed at the side and fitted with a push-button control. A multiple V belt drive is used, and the power is transmitted to the single driving disc, through a horizontal lay shaft capable of slight longitudinal movement by means of the press control lever. On the downward or working stroke, the outer flat face of the single friction disc is put into contact with the leather strip-faced, top fly-wheel, which gives the downward stroke of the press. Shortly before the end of the stroke the disc leaves the face of the fly-wheel, and a downward hanging or pendulum drive is brought into contact with the back conical face of the same driving disc, and engages a leather-covered pinion with the inside of the lower fly-wheel disc giving a quick constant-velocity return motion. The ram is arrested at the top of its stroke by an automatic brake, operating on the outer rim of the lower wheel. The adjustable controls are conveniently arranged at the side of the press. The patented pendulum drive is claimed to have many advantages over the double-disc drive, and the power required is stated to be extremely small, while a high efficiency is maintained.

A new machine shown on this stand was the guillotine shear with a drawing cut which we illustrate in Fig. 11. This machine also incorporates in its design the firm's fabricated steel plate construction, and it has been specially designed to shear narrow strips of thick and thin plate or strip, in a manner which ensures that they remain perfectly flat without curl or bend, and so can be immediately employed in folding presses or other similar machines without having to go through a subsequent straightening process. The upper knife is, by an arrangement of levers, made to perform a combined vertical and diagonal motion downwards, which gives the drawing cut. The diagonal motion of the knife can be adjusted to give a cutting angle from 3 deg. to 1 deg. for light shears, and from 5 deg. to 3 deg. for heavy shears, which ensures, we understand, the maintaining of absolutely flat work. Our illustration clearly shows the levers operating the knife and those actuating the front holding-down plate. In connection with this special machine, two examples of folding presses, one a 20-ton and another a 200-ton machine, were on view.

Another series of machines, see Fig. 12, are the new nibbling shears and punching machines, which have been designed to cut shapes from any point within a metal sheet, without pre-punching. These machines can also be used for trimming sheet or for dividing and splitting sheet metal or carrying out either straight or curved ribbing or beading operations. The bottom tools and downholders are interchangeable, while the upper cutter head can revolve and is driven by a 1400 r.p.m. electric motor through a flexible coupling placed between the excentric and the driving shaft of the motor. Some of the machines have a cone pulley drive, so that the number of strokes

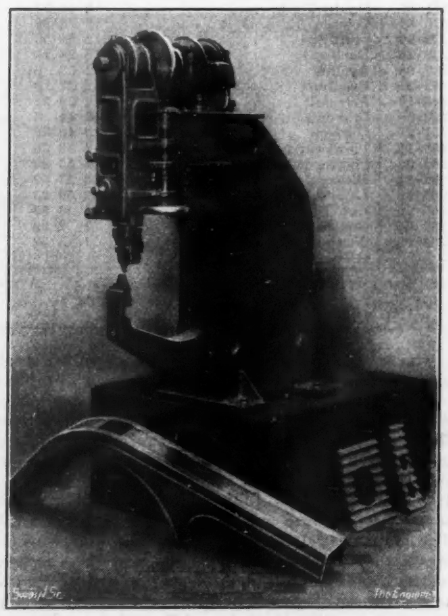


FIG. 12—NIBBLING SHEARS—PELS

per minute can be varied to suit light or heavy work. The upper blade can be raised or lowered by turning a hand wheel, so that shearing can be started by the point of the tool at any position in a plain sheet. As our illustration shows, the frame of the machine is built up of steel plates, with welded feet, and a horn for supporting the bottom tool.

J. F. OHLER.

The electrically driven hydraulic feed sawing machines, shown by Joh. Friedrich Ohler, of Remscheid-Vieringhausen, embodied several improvements on the original machine which appeared at the 1932 Leipzig Fair, and was briefly described in our issue of March 11th, 1932. There were three sizes of machines on the stand, one of the largest being illustrated in Fig. 13. The range of machines allows saw diameters of from 275 mm, or 10¾in., up to 710 mm., or nearly 28in., to be used, each machine being designed to carry more than one diameter of saw, thus giving, in conjunction with the six saw speeds, a wide machining range, which can be adapted to give the best conditions for economical working. In the older machines a belt drive was used, with a gear box in the upper bridge piece. That arrangement has now, however, been superseded by a direct drive for the saw, which consists of a motor and a worm drive with a six-speed gear-box running in an oil bath and mounted on the back of the saw carriage with conveniently grouped speed change levers. The box form of bed, which contains tanks with the lubricating oil and cooling fluid pumps, also the drawer for removal of saw cuttings, forms a base for the two vertical pillars on which the saw carriage slides up and down, while a strong bridge casting completes the closed frame of the machine. This arrangement gives, we found, a very even and steady running saw, which can be fed at high cutting speeds without vibration. The controls for the downward cutting stroke of the saw, the quick return stroke, also the closing of the vice and the forward and backward movement of the material on revolving rollers, are all hydraulically operated, and the control levers are neatly grouped at the side of the machine. The continuous feed has a range from 0 mm. to 500 mm., or 19 11/16 in. per minute, with a quick return of 0 mm. to 3000 mm. per minute for the large machine and a slower return speed for the small machines. All the saws used are of the firm's own inserted tooth pattern, for which special grinding machines have been designed. These were also shown in operation on the stand.

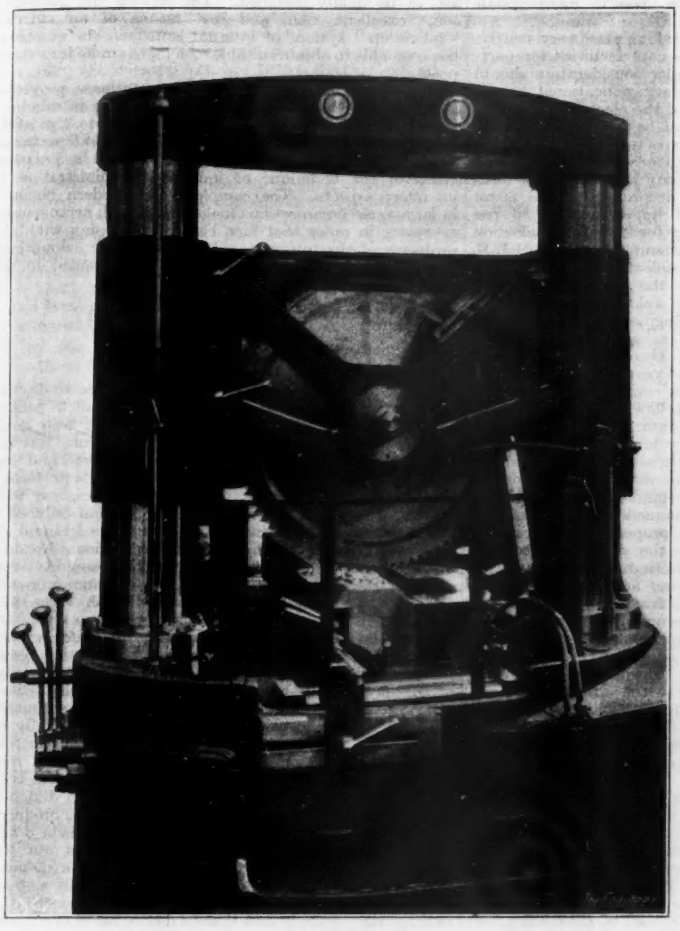


FIG. 13—HYDRAULICALLY OPERATED SAW—OHLER

FRIEDRICH SCHMALTZ.

From the wide range of grinding machines shown on the stand of Friedrich Schmaltz G.m.b.H., of Offenbach-am-Main, we have chosen for illustration a new type of grinding machine for finishing radial axle-boxes, which has been produced by the firm in collaboration with Reichsbahn Oberrat Schmidt, of Paderborn. As Fig. 14 shows, there are two outer grinding heads and also a central grinding head. The table has an oscillating motion about a centre between the arched frame of the machine, so that radial surfaces can be ground. The machine is electrically driven and the usual grinding wheel controls are provided so that, in addition to the radial axle-box grinding for which the machine was specially designed, a good range of other grinding work can be done. Another interesting machine on this stand was an automatic piston ring grinder with a pneumatic table feed, which is designed to grind the top and bottom sides of piston rings parallel with an accuracy of 0·005 mm.

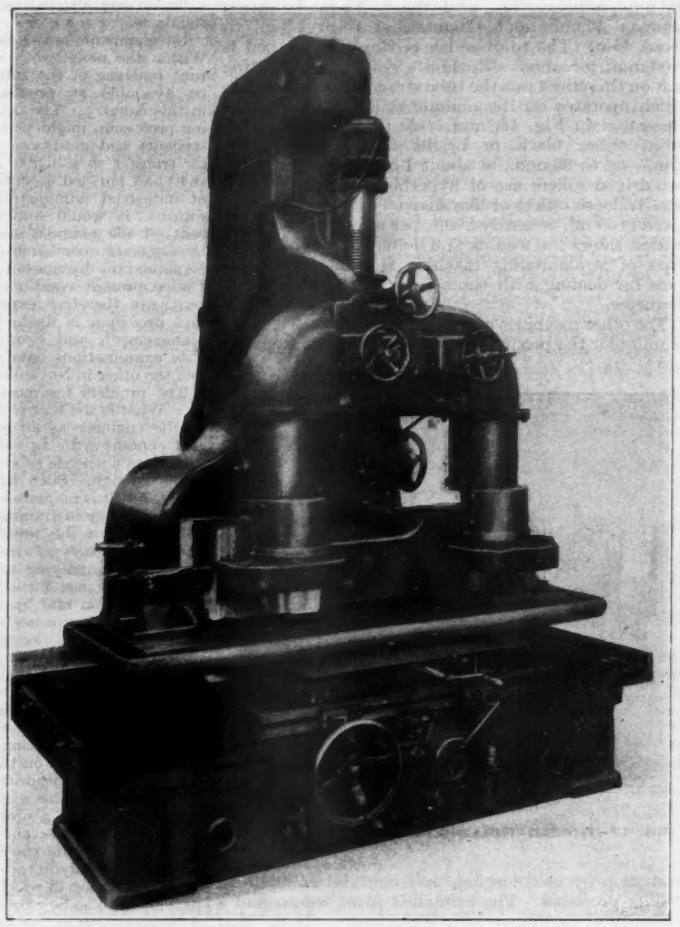


FIG. 14—AXLE-BOX GRINDING MACHINE—SCHMALTZ

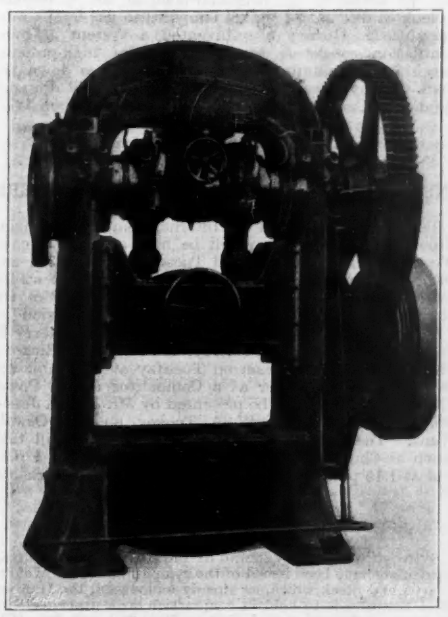


FIG. 15—FORGING PRESS—KIESERLING

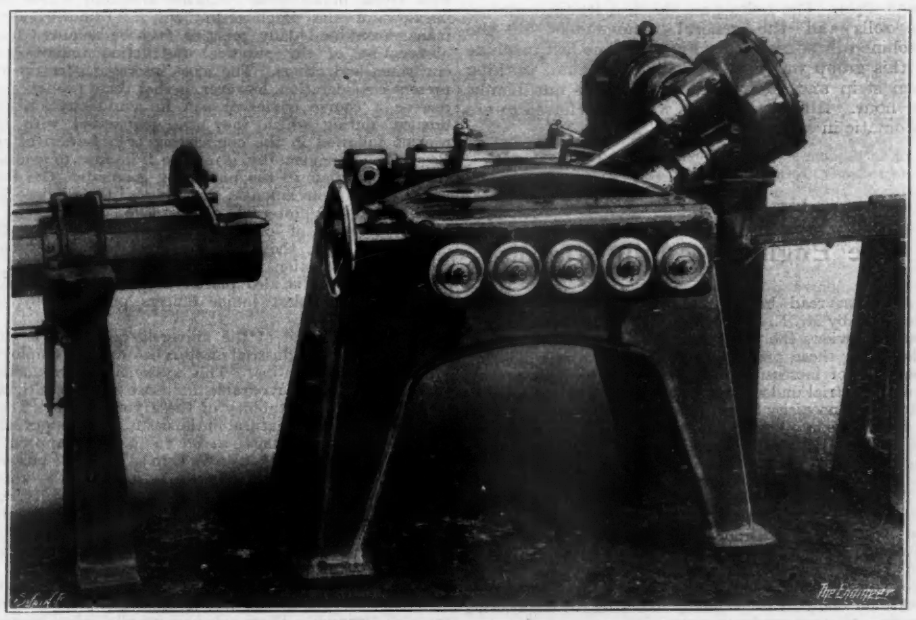


FIG. 16—TUBE-STRAIGHTENING MACHINE—KIESERLING

Kieserling and Albrecht.

One of the principal exhibits on the stand of Th. Kieserling and Albrecht, of Solingen, was the 200-ton vertical hot forging excentric press, illustrated in Fig. 15. It is very wide in order to admit of a sequence of operations being performed during the forging of small components. The same machine can also be employed for cold pressing and punching work. The ram can be adjusted in a vertical direction about 100 mm., or nearly 4in., while the stroke can be varied between 30 mm. and 120 mm., or from 1 3/16 in. to about 4¾in. The total width of the machine bed is 1500 mm., or about 4ft. 11in. Another interesting unit on this stand was the tube straightening machine, which operates on the oblique roller system. It is illustrated in Fig. 16, and is designed to deal with tubes either black or bright from 10 mm.—say, 7/16 in.—up to 30 mm., or about 1 3/16 in. diameter. The two driven rollers are of hyperbolic form and there are five loose rollers of like shape. The straightening speed is 60 m., or nearly 200ft. per minute. Our illustration shows the feeding and delivery troughs. This type of straightening machine is built in various sizes for dealing with tubes from 7/16 in. up to 13¾in. diameter.

The other machines on this stand comprised a group of units for the production of bolts and nuts from rod

Fig. 17—Thread-Rolling Machine—Kieserling

and strip by cold forging, pressing, and cold thread rolling processes. The combined plant shown had a capacity of 28,000 pieces in eight hours. In the first machine the rod was set up to form a round bolt head by two successive blows. The control and discharging mechanisms of the machine are of the firm's patented type and the machine has an output of seventy 7/16 in. bolts up to 3½in. long per minute. In the second machine the round heads are cut and pressed to form a hexagon, and the fine fin which remains after the pressing process is at the same time automatically removed, leaving a clean and accurately formed hexagonal head to the bolt. In the third machine the thread is rolled on the bolt up to lengths of about 2½in. The bolts pass down a feeding race to the rolls and the general arrangement of the machine will be seen from Fig. 17. The last machine in this group was a nut pressing machine, working from strip and delivering up to 3500 nut blanks per hour. All the machines we have referred to are automatic in operation.

(To be continued.)

The Engineer Administrator.

A paper read before the Institution of Electrical Engineers by Mr. E. S. Byng on "The Engineer Administrator," reviews the position of the electrical engineer in relation to those problems of administration which are becoming of increasing importance in the management of all industrial undertakings and public service organisations. The necessity for suitable training at an early stage is emphasised, and the educational facilities available are examined with the object of encouraging the young engineer of to-day to equip himself systematically for the duties and responsibilities of an engineer administrator.

The basis upon which instruction in industrial administration is being founded is reviewed, and subsequently the measures to be adopted in making available such education are considered. The alternatives suggested are: (1) A course consisting of one hour's lecture per week, during the final year at college; (2) post-graduate course for one year immediately following the engineering course; (3) post-graduate course for one year after two or three years of business experience; (4) part-time evening classes taken concurrently with experience in the works; (5) private courses in reading.

Education authorities, the author explains, have long contended that the available hours of study are already too fully occupied and that no time remains for additional subjects. The interests of students who cannot take the post-graduate course will, however, best be served by furnishing some opportunity for them to acquire knowledge of the fundamentals of industrial administration and thus enable them to follow up the subject seriously at their own discretion. Such preliminary education in the subject should be feasible, even if only one hour's lecture per week is possible.

The question arises whether those who are prepared to spend a further year at a post-graduate course should do so immediately following graduation, or after some business experience has been gained, when there is greater maturity of mind and the subject should have acquired greater significance. The latter course is preferable, but, unfortunately, is not always practicable. The compromise of part-time study at evening courses already available in many towns remains, however, as a favourable alternative, and is open to many junior engineers.

Developments in this field are taking place very swiftly. Within the next two years adequate facilities for part-time teaching of the subject under consideration should be available at practically every educational centre in this country. The interests of the electrical engineering profession might perhaps best be served if all I.E.E. students and graduates were expected, before applying for transfer to a higher grade, to produce evidence that they had pursued a course of study in the fundamentals of industrial administration. According to the latest returns, it would appear that approximately 86 per cent. of the candidates applying for transfer or election to associate membership are exempt from the I.E.E. Examination by reason of qualifications already held. Under present conditions only the balance of 14 per cent. are therefore expected to take the examination, and provision is made for "Engineering Organisation, Management, and Economics," as an optional subject. Two examinations have already been held, one in May, and the other in November of last year.

The problem for most serious consideration seems to be: What is the best course to follow in the development of the engineer as an administrator? That he should rest content with an elementary knowledge of administration as a science as already discussed is not considered to be enough. Such instruction may be an important phase, but it is no more than a beginning.

The analogy of training for the medical profession may help to place the problem in proper perspective. In the earlier days of medicine, the generally accepted method of qualifying was to work under the direction of a practitioner for some years, acquiring knowledge by observation and by learning from mistakes made at the patients' expense and discomfort—or even worse. By slow degrees lectures, supplemented by hospital observation and practice, were admitted as superior and quicker methods of qualifying. The wonderful developments in teaching and training in the art of healing are well known. The medical profession is about to set a further example of great significance to all other professions by inaugurating "refresher" courses for practitioners, very much on the lines employed for a long time by the military authorities.

Emulation of this example in education for industrial administration as a profession has already begun in the delivery of lectures and the inauguration of classes for students, but so far the equivalent of hospital observation has occurred only in rare instances.

An institution in which work of this character has been developed to some extent is the Department of Business Administration at the London School of Economics. In its use of the "Case" method for post-graduate students of business administration, and in other aspects of its teaching, this Department offers the nearest business equivalent to hospital training at the moment.

One of the most stimulating examples of organised executive training is to be found in the establishment of a training school by the Post Office Engineering Department. Graduates and others who have been appointed as probationary assistant engineers spend the first four months of their probationary period of two years at the Dollis Hill training establishment. Here they are brought into intimate touch with the practice of the Post Office in all those branches that fall within the purview of the Engineer-in-Chief. A knowledge of management and daily practice may be acquired from observation of the practical instruction imparted to craftsmen and others. The most interesting feature for present consideration, however, is that these probationers receive a course of instruction in administration and finance, during which they are acquainted with the routine followed in the engineering organisation of the Post Office. Incidentally, it may be of interest to mention that, in addition to the university graduates, the Post Office selects from amongst the ranks of the Engineering Department by internal competitive examination a certain number of officers as probationary assistant engineers. Thus, the university candidate is not only given the instruction required owing to his method of recruitment, but is also placed in immediate competition with the ablest junior officers produced by the organisation.

The trained mind of the university graduate is thus given direction in industrial matters before being employed upon executive routine. This systematic introduction to realities has a favourable influence on the ultimate usefulness and adaptability of these young men. There is no risk of their natural enthusiasm being suppressed at a very critical stage, as so frequently happens in industry. Similar methods may help to solve the problem of preparing for his future career in industry the young graduate fresh from the university. Large as the Post Office Engineering Department is, it is small compared with industry as a whole. That which the Engineer-in-Chief is doing for the Post Office *personnel*, industry might do as effectively for its own needs.

It is true that a few of the larger business organisations in this country are now applying original schemes for staff training. These schemes usually relate to what are variously called trainee, cadet, or student systems, and are confined to university graduates or existing employees who show special merit.

For over twenty years Standard Telephones and Cables, Ltd., has provided a student's course in electrical communication. The course begins each year shortly after the final university examinations and covers a period of twelve months. The students enter their training in small groups under the direction of an educational supervisor, and are first passed through a short course in which they are made acquainted with the company's organisation and business methods in general. During this period, lectures are given and tours of inspection are arranged to the company's factories and to telephone exchanges. Sufficient time is spent in the various divisions to enable the students to obtain a clear appreciation of the company's activities. This preliminary course facilitates subsequent training in one of the major departments, *e.g.*, manufacturing, installation, engineering, commercial, and accounting, where the training is semi-specialised. For the final three months of the training period the students are passed into an advanced section more particularly concerned with the work to which they are to be finally assigned. The scheme has produced some excellent men, and by means of an efficient "follow-up" system of internal transfers, the company has been able to obtain suitable men for the more important posts.

In some schemes already devised for trainees, provision is made, however, for more definite training in administration by appointing them as "assistant to" existing executives; they pass successively from one department head to another until they have acquired a practical grasp of the technique of industrial administration in its many aspects. The complexity of modern business in large-scale organisations makes some such arrangement necessary in order that men capable of coping with the problems of the future may be forthcoming; doubtless, similar more efficient schemes will be developed to the same end.

SIXTY YEARS AGO.

The Gurney steam road carriage appears to-day to be so far away in past history that it is difficult to believe that there must be many people still living who knew Gurney in his old age. Sir Goldsworthy Gurney was the son of Mr. John Gurney of Trevorgus, Cornwall and was born in 1793. He was educated for the medical profession but in his youth he was thrown into association with Davies, Giddy and Trevithick and from them imbibed a love of mechanical science. For a time he lectured on chemical science at the Surrey Institution, London. While still acting in that capacity his thoughts were directed towards steam locomotion on common roads. In 1822, so we read in our issue of March 12th 1875, he stated in the course of a public lecture on chemistry that "elementary power was capable of being applied to propel carriages along common roads with great political advantage and that the floating knowledge of the day placed the subject within our reach." Soon afterwards he constructed a small locomotive, presumably a model, which, so we recorded, worked successfully on ammoniacal gas. That experiment proved so satisfactory that he passed on to the construction of a steam road carriage. In 1826 he ran this carriage on several trips in the neighbourhood of London and found no difficulty in causing it to ascend Highgate Hill. In 1827 he produced an improved steam carriage with which he made a trip from London to Bath. On one occasion he ran this carriage from Melksham to Cranford Bridge, a distance of 84 miles, in ten hours. In 1831 Gurney built a steam carriage for Sir Charles Dance. For four months this carriage ran regularly four times a day between Gloucester and Cheltenham. The distance of 9 miles was generally covered in fifty-five minutes. Altogether this carriage ran about 3564 miles and transported about 3000 passengers. It was eventually driven off the road by the prohibitory turnpike rates, and by the wilful opposition to it manifested by certain malicious individuals. In addition to his activities in connection with mechanically propelled road vehicles Gurney displayed great inventive talent in diverse directions. In 1825 he invented the oxy-hydrogen light which was tried for the first time for street illumination on January 10th 1842 at Waterloo-place, Pall Mall. It is recorded that the new light caused the gas lamps in the neighbourhood of the Athenæum to look as dim as did the oil lamps when gas lamps were introduced. Gurney also invented a system of mine ventilation consisting of the release of high-pressure steam from a number of jets some distance down the shaft thereby causing it to establish an upward draught. He died in Cornwall during the early days of March 1875.

INSTITUTION OF MECHANICAL ENGINEERS.

The Spring Meeting of the Internal Combustion Engine Group of the Institution will be held at Storey's-gate, Westminster, on Monday and Tuesday, March 25th and 26th, 1935. On Monday the members will meet at the Institution at 2.30 p.m. and after the election of the Committee papers will be presented for discussion on "Supercharging," by Mr. A. H. R. Fedden, Mr. Sterry B. Freeman, Mr. L. E. W. Pomeroy, and Mr. H. R. Ricardo. The subject for discussion on Tuesday at 9.30 a.m. will be "The Gas Engineer as a Competitor in the Power Field," and papers will be presented by Mr. Joseph Jones, Mr. E. J. Tatman, Mr. W. A. Tookey, and Mr. Oswald Wans. The members attending the meeting will take lunch at Church House, Westminster, from 12 to 1 p.m. and at 1.15 p.m. visits will be made to selected works.

Symposium on the Welding of Iron and Steel.—Further particulars have been issued of the symposium on the Welding of Iron and Steel, which, as already announced, the Iron and Steel Institute is to hold in conjunction with other technical societies on Thursday and Friday, May 2nd and 3rd, 1935. The group of papers presented on the first day will deal with the Present-day Practice and Problems of Welding in the Engineering Industries; Bridge and Structural Engineering; Pressure Vessels; Railway Material; Shipbuilding, Aeronautical, Automobile, Chain, and Electrical Industries; Iron and Steel Castings and Wrought Iron. The second group of papers to be given on May 3rd will concern Welding Practice and Technique and Welding Apparatus; Metallurgy and Welding; Specification, Inspection, Testing, and Safety Aspects of Welding. A conversazione in connection with the symposium will be held at the Science Museum, South Kensington, on May 1st, and a dance on May 3rd. Full particulars of the meetings and papers are obtainable from the Iron and Steel Institute, 28, Victoria-street, London, S.W.1.

Rail and Road.

THE greater part of the road haulage of railway companies is for the short distances to and from railway stations, and so differs from the business of the ordinary road hauliers. That restricts the average mileage obtainable per motor vehicle to a little under 9000 per annum. The relatively low mileage obtainable is one of the reasons why railway companies still have a number of horse-drawn vehicles.

IT was satisfcatory to hear from Sir Josiah Stamp, on March 1st, that whilst the receipts from the L.M.S ancillary businesses fell by £900,000, the expenditure thereon was reduced by £1,300,000. The steamboat services in particular had a loss of £290,000 in receipts, but it was accompanied by a drop of £310,000 in expenditure, and, actually, the year as regards that traffic yielded the best results of any year on record.

IT was stated at the annual meeting of the Southern Railway Company that the number of journeys made by passengers, including those of season ticket holders, was 338,000,000, which was a record; the previous highest was 330,000,000 in 1930. Of the increase of 13,600,000 passengers, no less than 11,000,000 were carried on those sections where the line had been electrified. The total receipts from passengers on the electrified lines increased by £302,000.

IT was recently reported to the proprietors of the Southern Railway that a serious and unforeseen difficulty is being experienced in the carrying out of the work at Dover for the Dover-Dunkirk train ferry, owing to the appearance of a small fissure in the chalk entirely outside the experience of any geologist. Consequently, the expectation that the work would be opened in the coming summer will not be realised. There was no prospect of the company being able to open the service until early in 1936.

THE first of a batch of twenty new two-cylinder 2–6–2 superheated tank engines has just been completed at Derby Works to Mr. Stanier's designs. They are to be numbered 71–90 inclusive. The company already possesses seventy engines numbered 1–70 inclusive, having the 2–6–2 wheel arrangement, and the new engines have been designed as a development and improvement of the earlier type. The cylinders are 17½in. by 26in., and the coupled wheels 5ft. 3in. in diameter. The tractive effort at 85 per cent. of the boiler pressure (200 lb.) is 21,486 lb.

DEFINITE progress can now be reported as to a joint Municipal Passenger Transport Board for South-East Lancashire and East Cheshire. A scheme, prepared by the treasurers of the transport bodies concerned, was submitted to a meeting at Manchester on March 5th. That recommended that the proposed Joint Transport Board should purchase the seven undertakings on a basis of two years' gross revenue. The report was referred to each of the undertakings for approval, and a further meeting will be held as to the promotion of a Bill in Parliament. The total gross revenues are about £4,000,000 a year.

FROM the answer given to a question addressed to the Minister of Transport on March 6th, it appears that the London Passenger Transport Board shares the views of the London and North-Eastern Railway Company as to the cost of the electrification of the railways in East London not being financially warranted. The Board had informed Mr. Hore-Belisha, however, that while it agreed that the great cost of widening the track and the character of the traffic to be carried would not make electrification a profitable investment, the whole problem was having the careful consideration of the Standing Joint Committee which represented the Board and the main line companies.

AN aspect affecting the question of high-speed trains, such as those driven by oil-electric engines, is that a "path" is necessary for them in the time-table, so that they may be sure of a clear road, otherwise their very purpose would be defeated. That means that slower trains—passenger as well as freight—must be kept back or shunted; moreover, the trains that have to be shunted must be disposed of some minutes before the high-speed train approaches. There are lines where the density of the traffic is so relatively small that such conditions are permissible, but, in the judgment of Sir Josiah Stamp, that is not so on the L.M.S. Speaking at the annual meeting, he said that, with his company's flow of traffic and dense line occupation, the problems could not be met by a mere repetition of methods adopted elsewhere.

THE experience gained by the London and North-Eastern Company in the running of a high-speed steam train from King's Cross to Newcastle and back, as related in our Seven-Days' Journal on March 8th, following on the previous run to Leeds and back, is to be put to practical effect. Mr. Whitelaw, speaking at the L.N.E.R. meeting on March 8th, said that the results were so encouraging that the board would give its immediate consideration to the question of putting on one such train to run between King's Cross and Newcastle during the autumn. There were many details requiring careful investigation before a final decision could be arrived at. If such a train was run it would be appropriately named the "Silver Jubilee Train," although, for a variety of reasons, it would not be possible to include it in this year's summer time-table.

THE London, Midland and Scottish annual report for 1934 shows that the receipts from railway working were £60,571,587, and the expenditure £49,563,211, as compared with £58,185,439 and £48,223,760 respectively in 1933. Though the expenditure was higher its ratio to receipts was 81–83 in 1934, as against 82–88 in 1933. The number of passenger journeys increased from 289 millions to 302¼ millions, but the receipts from passengers rose only from £15,425,598 to £15,885,882. As the average fare per passenger fell from 1s. 0·81d. in 1933 to 1s. 0·61d. in 1934, it is evident that the increase in the numbers was due to the monthly cheap return tickets. As on the Great Western the first-class traffic increased, but the L.M.S. had a reduced, and not an increased, average fare therefrom. The tonnage of freight traffic advanced from 115,832,653 tons, at an average of 5s. 7·87d. per ton, to 124,408,581 tons at 5s. 6·88d. per ton.

Miscellanea.

THE coal resources of the Union of South Africa have been estimated by W. Wybergh as amounting to 226 thousand million tons.

THE rated capacity of the electricity generating stations of Russia has been more than doubled since 1930, and now stands at 6,212,000 kW.

THE new "cut" in the Thames, between Weybridge and Walton, in addition to forming a flood relief channel, will be available as an alternative route for navigation by June 30th.

IN the course of constructing the cut-off wall of the earth-fill dam, which is being built across the Missouri River at Fort Peck, steel sheet piling has been driven to the record depth of 156ft.

THE Coleford Improvement Association has decided to petition the Government for assistance in reopening the iron mines of the Forest of Dean. It is estimated that the scheme would involve the expenditure of £50,000.

WRITING in the *British and Russian Gazette*, Louis Fischer says that as a result of piecework payment in the Russian factories, "many electric bulbs spoil after ten days' use and that some shoes wear out in a month."

A NOTE in *Steel* says that wire is now being annealed in an atmosphere of methanol gas which changes the surface smut to amorphous carbon. This need not be cleaned from the surface, inasmuch as it serves as a lubricant in the next pass through the dies.

A NOTE in the *Scientific American* describes a new bearing material for under-water work. It is known as "Eel-Slip," and is a composition of asbestos, graphite, and rubber, which forms a tough but easily machined product, with a low coefficient of friction, the best lubricant for which is water.

THE chilled cast iron calendering rolls for the new 310in. wide paper machine of Edward Lloyd, Ltd., which, as we have already announced, is being built by Walmsleys, Ltd., have just been completed by Miller and Co., of Edinburgh. There are eight of them, ranging in diameter from 36in. down to 20in., and the total weight is 133 tons 10 cwt.

As a result of the annual meeting of the Chinese Government Purchasing Commission, orders to the value of £200,000 will be placed with British firms for machine shop equipment. The value of contracts placed with British firms in 1934 was £1,849,979, bringing the total value of orders since the Commission began work to £2,915,025. The total tonnage of materials imported during the year was 89,437.

IN these days when so many scientific and technical societies exist the selection of the most suitable day and time for meetings requires much thought. A recent postal vote taken by the Illuminating Engineering Society led to interesting results. There was an overwhelming preponderance of votes in favour of Tuesday, the day on which the I.E.S. meetings are now held. The numbers of votes cast for meetings starting respectively at 6 p.m. and 7 p.m. were exactly equal. As, however, it was understood that those who did not vote approved of the existing arrangement, it was decided to continue with the time at present adopted, namely, 7 o'clock.

A SCHEME to extract oil from South Wales coal has been drawn up by a sub-committee of South Wales and Monmouthshire Industrial Development Council, says the *Chemical Trade Journal*. The outlay is estimated at £7,000,000, and it covers the instalment of ten low-temperature carbonisation plants and one hydrogenation plant in the south and eastern part of the Welsh coalfield. The proposed hydrogenation plant is estimated to cost £4,500,000, and the ten low-temperature carbonisation plants of 1000 tons capacity each to involve an expenditure of £2,500,000. Employment would be found for 5000 miners and 2000 process workers.

A NEW type of glass which, it is claimed, influences both the temperature and lighting of buildings with which it is glazed was demonstrated recently by the Thermolux Glass Company. The new product consists of two panes of ordinary clear glass with a middle layer of fibrous glass. It was stated that the disposition of the glass silk is such that the rays of the sun do not pass through it as they would through ordinary clear glass. The light instead is distributed perfectly evenly, giving greater effective lighting without shadow, although not actually transmitting so much light. The value of this new type of glazing is accentuated by the heat-insulating properties possessed by glass silk.

THE Official Returns rendered to the Electricity Commissioners show that 1478 million units of electricity were generated by authorised undertakers in Great Britain during the month of February, 1935, as compared with the revised figure of 1343 million units in the corresponding month of 1934, representing an increase of 135 million units, or 10 per cent. The number of working days in the month (*i.e.*, excluding Sundays) was twenty-four, the same as last year. During the first two months of 1935 up to the end of February, the total amount of electricity generated by authorised undertakers was 3192 million units, as compared with the revised figure of 2879 million units for the corresponding period of 1934, representing an increase of 313 million units, or 10·9 per cent.

A PROCESS has been developed by the American Chemical Paint Company, whereby cleaned steel surfaces are conditioned or treated for extending the life of finishing materials without spoiling the lustre of the applied finish. The process uses a crystalline solution known as "Cromodine," and consists of first removing the oil and rust from the surface. The parts are then immersed into the heated Cromodine solution, in which they remain for a minute. They are next removed and rinsed in a tank of cold running water, and then, by immersing them into a bath of hot water, the drying of the surface is hastened. A powdery residue is left, which in most cases should be removed by wiping, after which the surface is ready to receive the priming coat of paint. This process, it is said, provides an excellent foundation for high-bake enamels, as well as synthetic materials and oil primers.

Air and Water.

THE second of the new Blue Star Australia and New Zealand food ships, the "New Zealand Star," has passed her trials and been handed over to her owners.

A NEW record has been set up on the New York to Plymouth trip *viâ* Queenstown by the U.S. liner "Manhattan" completing the voyage in 5 d. 14 h. 20 min.

IN her first year of service the Huddart Parker motor liner "Wanganella" has traversed 80,025 sea miles. The average fuel consumption is given as 25 tons a day. The "Wanganella" was built at Belfast by Harland and Wolff.

To be used chiefly on long distance charter work, Imperial Airways has recently acquired two Avro 652 low-wing twin-engined monoplanes. Fitted with "Cheetah V" engines, they will have a cruising speed of about 150 miles per hour.

FOR the completion of the second part of the Portuguese naval building programme, tenders are to be invited for the construction of five destroyers and three submarines. The first part of the programme comprised fourteen ships, nine of which were constructed in British shipyards.

IT is announced by North-Eastern Airways, Ltd., that commencing at the beginning of April they will operate a daily air service between London, Leeds, Newcastle-on-Tyne and Edinburgh. The journey between Heston and Edinburgh, including intermediate stops, will take 2¾ hours.

PREPARATIONS are being made to open a new steamboat line between Moscow and Archangel by the beginning of the navigation season. This line will extend to 3405 kilom., and be the longest river line in the world. It will connect a number of important areas and cities, including Kolomna, Ryazan, Kasinov, Gorky, Yaroslavl, Rybinsk, Vologda, and Kotlas.

ACCORDING to figures issued by the Swedish Shipowners' Association, there was a further increase in the number and tonnage of vessels laid up in Sweden and Norway in February. The number of vessels of 100 tons gross and over laid up on March 1st was 260, of 263,233 gross tons, compared with 223 vessels, of 223,119 gross tons, on February 1st.

A NOTE in *Flight* says that the Essex airport, Stapleford Abbotts, is being equipped with a new type of boundary light developed from the "Pillar of Fire" traffic guides. Not only is the pillar itself illuminated, but the beacon throws an unmistakable circle of light around the wide base, which is painted white. The beacons give way and disconnect easily if touched by the taxying machine.

THE new stem piece for H.M.S. "Renown," the bow of which sustained damage while in collision with H.M.S. "Hood," was completed ready for delivery in the short space of twenty days by Wm. Beardmore and Co., Ltd. The casting measures 40ft. by 21ft. and weighs 14 tons. It was taken from Parkhead to Glasgow by road and shipped to Portsmouth, where the "Renown" is in dry dock.

AT a recent meeting the Clyde Navigation Trust decided to make a general reduction of 10 per cent. on the charges for the hire of dredging plant. The minute dealing with the subject stated: "In view of the advantage to the community of the building of the quadruple-screw turbine steamer "Queen Mary," any dredging work still to be carried out in connection with the vessel should be charged at the existing rates, less 20 per cent."

AT a recent meeting of the General Committee of Lloyd's Register of Shipping Mr. J. Denham Christie, chairman of Swan, Hunter and Wigham Richardson, Ltd., and Mr. F. E. Rebbeck, chairman and managing director of Harland and Wolff, Ltd., were elected as representatives of shipbuilders and engineers on the General Committee. With these two additions, the number of representatives of shipbuilders and engineers on the General Committee is nine.

A DEMONSTRATION was recently given at Cardiff of a new type of life-saving device for use at sea, known as the "Flotanet." It consists of a flexible net to which cylindrical corks are fastened in such a manner as to give the maximum of buoyancy and maintain the form of the appliance in the rise and fall of the waves. Capable of supporting several persons, it can be unrolled down a ship's side, serving as a ladder and lowered into the sea with people on it.

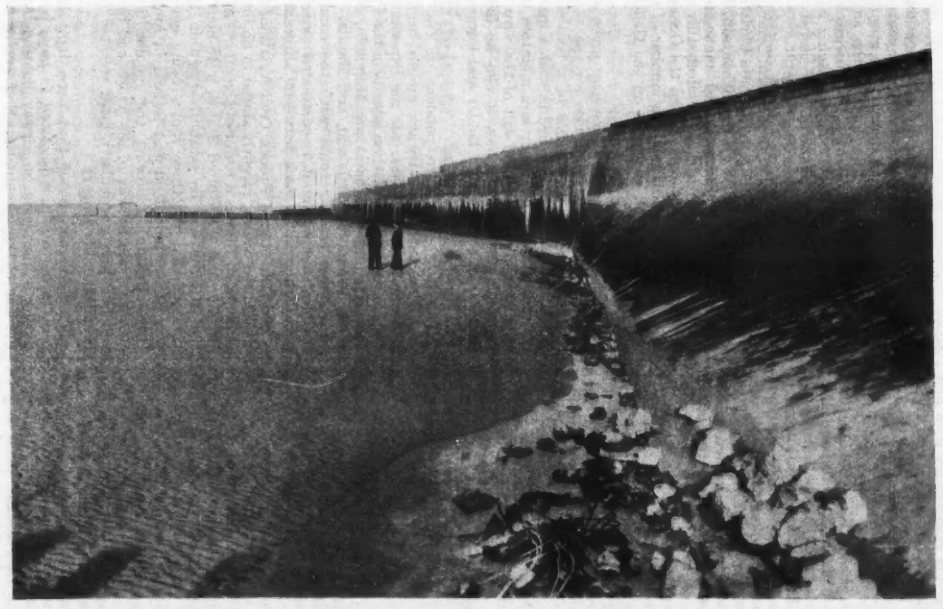
THE New York correspondent of *The Times* reports that Pan-American Airways are to begin constructing airway operating bases, for an experimental transport system to the Far East, on islands in the Pacific. Among the sites for these bases are Honolulu, Midway Island, Wake Island, Guam Island, and Manila. It is proposed to connect the air route with the company's Chinese Airlines, but before it is completed experimental transport flights will be made between California and Honolulu.

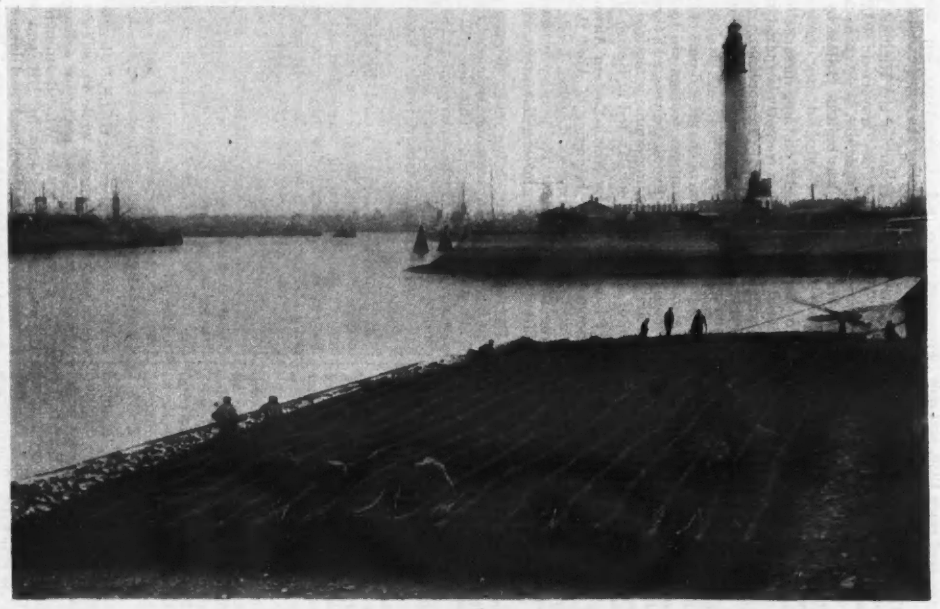
THE Director of French Civil Aviation, who is visiting the United States, recently stated in an interview that he anticipated that as a result of the efforts of France, Great Britain, and the United States, a 48-hour service across the Atlantic will be established within twelve months. He says that the three routes being considered are by way of Newfoundland and Ireland (a route favoured by Great Britain), following the regular line of Atlantic steamers, and by way of the Azores and Bermuda (a route which enjoys particularly good weather conditions, but is considerably longer).

THE common belief that neon light has special fog penetrating qualities is stated to have been disposed of during a discussion on airway lighting before a London meeting of the Illuminating Engineering Society. It was contended that neon light is scattered and absorbed by the atmosphere in just the same way as any other red light, and when visibility is down to a mile or less a neon light cannot be seen appreciably further than a white light of equal intensity. Details were given of a new form of airway beacon which will give noticeable indication to a pilot 30 miles away that he is as little as one mile off the normal course.

CONSTRUCTION OF NEW HARBOUR WORKS AT DUNKIRK

(For description see page 279.)





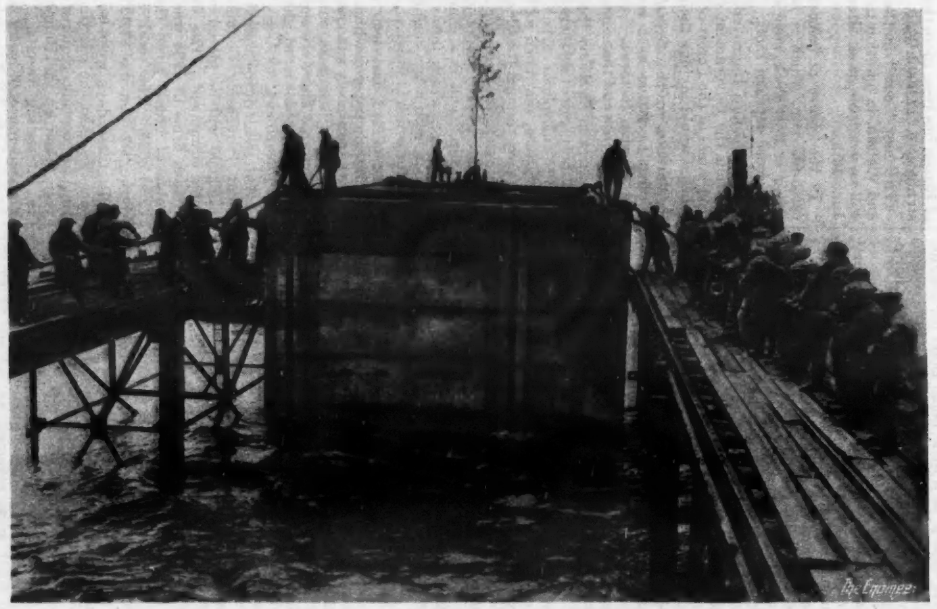


FIG. 1 (ABOVE)—WEST JETTY: JUNCTION OF PAVED SLOPE AND VERTICAL SUPERSTRUCTURE
FIG. 2 (BELOW)—CONCRETE BLOCK WORK IN MOUND OF WEST JETTY

FIG. 3 (ABOVE)—FASCINE MATTRESS FOR WEST JETTY FOUNDATIONS
FIG. 4 (BELOW)—PLACING CAISSON FOR EAST JETTY IN POSITION FOR SINKING

Hymn of Breaking Strain

The careful text-books measure
(Let all who build beware!)
The load, the shock, the pressure
Material can bear.
So, when the faulty girder
Lets down the grinding span,
The blame of loss, or murder,
Is laid upon the man.
Not on the Stuff—the Man!

But, in our daily dealing
With stone and steel, we find
The Gods have no such feeling
Of justice toward mankind.
To no set gauge they make us,—
For no laid course prepare—
And presently o'ertake us
With loads we cannot bear:
Too merciless to bear!

The prudent text-books give it
In tables at the end—
The stress that shears a rivet
Or makes a tie-bar bend—
What traffic wrecks macadam—
What concrete should endure—
But we, poor Sons of Adam,
Have no such literature,
To warn us or make sure!

We hold all earth to plunder—
All Time and Space as well—
Too wonder-stale to wonder
At each new miracle;
Till, in the mid-illusion
Of Godhead 'neath our hand,
Falls multiplied confusion
On all we did and planned—
The mighty works we planned.

We only, of Creation
(Ah luckier bridge and rail!)
Abide the twin-damnation—
To fail and know we fail.
Yet we—by which sole token
We know we once were Gods—
Take shame in being broken
However great the odds—
The burden or the odds.

Oh veiled and secret Power
Whose paths we search in vain,
Be with us in our hour
Of overthrow and pain;
That we—by which sure token
We know Thy ways are true—
In spite of being broken—
Because of being broken—
May rise and build anew.
Stand up and build anew!

RUDYARD KIPLING.

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The Engineer

MARCH 15, 1935.

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NOTICES TO READERS.

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WITH EMPHASIS.

AT the recent meetings of the Institute of Metals Mr. U. R. Evans said, during a discussion, "if a corrosionist had nothing to say about a paper, he should say it with emphasis, for it meant that he accepted it—and it was very important to obtain for their agreements the same degree of publicity as for their 'disagreements.'" Therein lies a sound principle. Opposition employs reasoned arguments, whilst agreement is frequently no more than unweighed acquiescence, as the unwary set their hands and seals to documents without mastering their meaning. How often does it happen on committees, even of technical people, that the members vote for motions which they do not understand! If Mr. Evans' principle that as much emphasis should be laid on agreement as on disagreement were more general, many things that are done would be left undone—sometimes for good, sometimes for ill. Too often motions are passed "by default," because there is no one to oppose their passage. It is a good thing when a committee is blessed—to the provocation of everybody upon it—with a troublesome critic, who is resolved to let nothing which he does not understand slip through, and to challenge everything he does not comprehend. The shrewd committeeman who has a motion on the paper dreads that type; the last thing he desires is a discussion on it. He wants to get it through quietly and without trouble, and he knows that if once the committee is roused to take notice of it, there may be endless talk, and that in the end he may lose it altogether. But that is not the common fate of motions. More usually a few members at the meeting know something about one thing, whilst the remainder know nothing about that subject, and often little enough about anything. The few knowledgeable men have therefore little difficulty in getting their way, and items on the agenda are passed without intelligent discussion.

Now a committee is a microcosm of the world as a whole; what *it* does in its small way, society does in the great. On few subjects and in few instances it thinks for itself. It rarely shows the scientific spirit; it accepts without inquiry, and endorses on the recommendation of a friend. To day, Mr. Kipling has afforded us the great honour of publishing for the first time one of his poems. It is fitting that we should recall another poem of his which bears upon the subject in hand. It recalls the posthumous fate of "Tomlinson" of Berkeley Square, who could gain admittance neither to Heaven nor Hell because he had never thought or acted for himself, and was sent back to earth to learn that no action, good or bad, is worth a blessing or a curse if it be done "two by two" instead of "one by one." The Devil ejects him on the recommendation of an expert and conscientious committee with these words:

> "Go back to Earth with a lip unsealed—go back with an open eye,
> And carry my word to the Sons of Men or ever ye come to die;
> That the sin they do by two and two they must pay for one by one
> And . . . the God that you took from a printed book be with you, Tomlinson."

We suppose that Tomlinson is still to be found in Berkeley Square; still, no doubt, sitting on committees and giving, without emphasis, his vote for motions for which he would not dare to take personal responsibility. To him Heaven and Hell will be for ever closed, for never on his own action will he merit one or the other. Yet had he only been compelled to give his agreement "with emphasis," he might have escaped, in one direction or the other, "the Wind that blows between the worlds," which "nipped him to the bone."

Yet would the poet be merciful to average men—all those who respond to Jacques' "Ducdame, ducdame, ducdame." If they never accepted without question, and without understanding, the opinions of others, the world would run down. In an age of specialists, each must rely upon the expert for things outside his own ken. Amongst engineers, one may meet with those who scorn such books as "Molesworth," "Marks and Davis," or "Kempe." They will go back to the rock bottom for their calculations and would rather derive their own units than take them from a table. All praise to them; it is such doubters who find out errors and discover new elements. If Rayleigh and Ramsay had not questioned the constitution of the atmosphere, argon and neon would still be undiscovered, and London would be less rosy than it is. But for mortals of commoner clay, whose immediate business it is to get on with their job, the only course is to shift some of their responsibility on to other shoulders and to accept with gratitude, if without emphasis, the assertions of specialists. That must always be the way with councils which are called upon to accept or reject the findings of their committees. It is not for them to do over again the work done by a few selected for the purpose; but it is for them to make greater decisions and happy they are if they can be sure that on their committees nothing has been allowed to pass by default.

Industry and Government.

IT is within the memory of all pre-war people that in those days the interference of the Government with industry was held to be an abomination. True, there were moments when this common attitude broke down. Now and again the governments of foreign powers took a hand in the gaining of contracts in open markets for their own nationals, and British manufacturers, having lost the order, made bitter comments about the supineness of the Board of Trade. But, broadly speaking, resentment against the interfering government was stronger than the wish that our own should follow its example. It was felt that it was not the proper function of any government to meddle with the business of industry, and when foreign states did so this country regarded their action as unfair competition. Other nations did not see the matter in that light; they played the game of business to different rules. But step by step Great Britain is leaving, or being forced to abandon, her position. The Government, which, a score of years ago had no more than its little finger in the industrial pie, has now got its thumb in as well, and the time may not be far distant when it will have its whole fist in it. Whether the present conditions would ever have occurred had it not been for the period of depression is an interesting problem with which economic historians of the remote future will entertain themselves. We suspect that they will find fairly clear indication of its approach long before the international slump fell upon the world, but that the rapidity of its movement was due to the distress into which industries fell. The sufferers, as their manner now is, turned to the Government to get them out of their trouble, and in response to the demand, the Government imposed duties and quotas, granted subsidies, fathered exhibitions and posters, and in various less spectacular ways began to help British industrialists against their foreign competitors, or to encourage them to do things which they would never have thought of attempting under open conditions.

There will always be violent differences of opinion about the wisdom of this new course. That means that there are admirable arguments on both sides. Each is able to make an irrefutable case—till the other has been examined. Those of the old school can point confidently to the high position Great Britain attained in open competition with the rest of the world by and through her "sturdy individualism." On the other hand, the reformers assert that, scientifically and statistically, competition can be proved to be more noxious than beneficial. They would like to see a planned programme in which every unit in every industry had its allotted share of work and its pre-ordained profits. The brigandage of cut-throat competition is odious to them; they will not admit that it bred a hardy self-reliant race of merchants and manufacturers who were proud to look after their own affairs, and if they failed, blamed no one but themselves. Lord Melchett, who, through his Industrial Reorganisation (Enabling) Bill, may, for the moment, be regarded as the leader of the advanced movement, would make industrial fraternity compulsory and is prepared to adopt the French method of inducing the unwilling to become your brother. His Bill would give compulsory powers to a majority of producers to compel all to adopt plans drawn up "with the general object of promoting greater efficiency, eliminating wasteful competition and facilitating the production, manufacture, and supply of the products of that industry." We have seen in America a vast scheme of a very similar kind put into actual operation, and in this country we are witnessing still the enormous difficulties encountered in the organisation of a single industry—the steel trade. If it could be said that the American experiment had met, or even showed clear signs of meeting, with ultimate success the arguments in favour of the removal of individualism would be far stronger than they are. But with few exceptions the New Deal in the United States has to all intents and purposes failed, and will only be kept in existence by a national expenditure of collosal proportions. On the main issue—that of the reduction of unemployment—it has achieved little or nothing, and clear indications that it has proved beneficial in any industry, with the possible exception of agriculture, are lacking.

The conditions which prevail in America are so different from those to be found in any other part of the world that it may be regarded as unfair to draw comparisons between her practices and ours. But there is, we suggest, a common factor. The United States started its national recovery campaign with a too strictly national outlook. America, it thought, was sufficient to herself. The whole vast machinery was set up to enable her to sup from her own breasts. She was to fatten and grow rich by the increasing consumption of her own products. She has now found that such isolation is uneconomical. "The issue for American producers and foreign consumers," writes Mr. H. O. Chalkley in a D.O.T. Report, issued a few days ago, "is the same, the one question whether the United States will permit itself and be permitted to distribute abroad, and be paid for, the superabundance of its capacity to produce, to the full extent of other countries' need and capacity to consume. As well as being the fundamental problem of American agriculture, it is the ultimate test of the American recovery effort and the determining factor in the future course of the foreign trade not only of America but of a large part of the foreign trading world." As long as individualism was the guiding star of industry, international trade problems settled themselves. But once industry began to expect the State to help it in its difficulties, excessive nationalism inevitably arose. In this country we are endeavouring, but with only half a heart, to avoid that condition, or, when it obtains, defending it on the grounds that our practices are designed to bring other nations to their senses. Therein lies grave danger. It is all very well to keep your wicket up by blocking tactics; but matches must be won by making runs, not by passive resistance of your opponent's attacks. In the days of the individualists attack came first and defence second. Now the position is being reversed, and every industry is turning to the Government, in all countries, to protect it from harm.

Mechanical Efficiency in Industry.

By L. M. ANGUS BUTTERWORTH, A.I. Mech. E.

IN recent years there has been a rapid acceleration in the development of mass production. It represents a revolution in the industrial field that has already had the most far-reaching consequences. And the prime agent in these changes has been the mechanical engineer.

Mankind has gained enormously from mass production. By means of it countless articles are made and sold at such low cost that they can be used by the million. Thus luxury has entered into the lives of great numbers of people in a way that would have been regarded as incredible, even a generation ago. Every-day life in any civilised community now demands a constant supply of products and conveniences for its poorest members that a short while ago not even princes could have afforded.

At the same time craftsmanship has become less important. Fortunately, as the machine has taken the place of the craftsman, it has been shown to be capable of producing articles of high artistic merit. Many things which to-day are machine made are clearly far more beautiful than their hand-made forerunners.

In a great industrial nation like our own, it is a condition of our existence that we should be able to manufacture goods at low cost. The population of England and Wales increased with very great rapidity during the nineteenth century, rising from 8,890,000 in 1801 to 32,520,000 in 1901. It is well known that this increase was closely associated with our leadership in the industrial world. We obtained prosperity because our methods of manufacture were in advance of those of the rest of Europe.

It came about that we were able to raise our standard of living at the same time that our population was shooting upwards in numbers. Sir Josiah Stamp has calculated that while the population increased about five-fold between 1800 and 1914, the income of the country multiplied about ten times. If we consider that in addition the purchasing power of money about doubled during the period, it is revealed that in it the nation became about four times as wealthy as before.

To support our population and maintain our standard of living we must continue to take advantage of the latest plant and of the new mass production system. Nor can we remain content unless the rise in real wages, and the slow but steady improvement in the condition of the working classes, also continue. Professor Carr-Saunders, in his work on "Population," points out that to accomplish these ends we cannot depend on agriculture, but must look to industry. He observes that "mechanical inventions can be introduced far more easily into industry than into agriculture. Improvements in technique are of almost daily occurrence in an engineering shop, whereas agricultural implements and the daily routine on a farm remain little changed over a period of years; secondly, division of labour and mass production when applied to industrial processes enormously increase efficiency and output."

Linked with mass production we often find excellent and highly organised "service" systems. Granted great volume of production, costs of "service after sales" are justifiable that could not otherwise be undertaken. In turn, such service tends to lead again to further sales, and we accordingly find more support for the view of Sir Eric Geddes that the terms "mass production" and "industrial efficiency" are synonymous.

It is generally desirable to attempt to define a term like "mass production," even if the conception of what it means varies greatly in the minds of different individuals. It does not mean duplicating hand workers without changing processes. In any industry in which mass production has been introduced we find intense specialisation. The work of the hand producer has been minutely analysed, and every movement studied. By reducing each operation into its fundamental component parts ingenious machines can be employed that work with complete accuracy and immense speed compared with their human counterparts.

In his book on "Industrial economics" an example is given by Professor Kimball of the saving obtained under the mass production system in the simple operation of drilling holes in the corners of square iron plates. To drill these holes in the same place in each plate by hand, taking every plate separately, would require considerable skill and be very costly. If a sufficient number of plates are in question, however, they can be clamped together and drilled by a power-driven jig. It was found in the case cited that the labour cost per plate fell from 6·840d. to 0·089d., showing a cost ratio of 77 to 1 in favour of the mass production method.

High wages are the rule under mass production. The operative in charge of a machine earns much more than the skilled craftsman did. This is partly because larger output is literally the creation of a greater amount of wealth, of which the worker has his share. In addition, the operative has more responsibility, for lack of attention or misuse of his machine might mean the ruin of thousands of articles in a short time. It is not even true that under mass production the worker degenerates into something little better than an automaton, for, as methods and processes are always improving, he must have ready adaptability to remain efficient. It is probably true that the general level of skill and intelligence is higher in industry to-day than at any previous time.

It might be thought that as under mass production there is a general tendency for industry to combine into larger units, the number of manual workers might increase at the expense of the mental workers, for duplication of management and scientific research staffs is, for example, avoided. In point of fact, however, the reverse has proved to be the case, and the *Board of Trade Journal* figures show that over a range of sixty-eight production industries, there has been a steady rise in the proportion of mental workers. In some trades, where old methods still survive because certain specialities can continue to find a market, the change-over from the hand producer may be relatively small. The trend in favour of the brain-working staff is most strongly marked in the more highly developed reproductive industries.

Figures collected by Sir Eric Geddes from manufacturers of tires, glass bottles, biscuits, and wafers, show that even with limited application of mass production methods labour costs have fallen from about 50 to 25 per cent. of the total factory or conversion costs in these industries. Sir Eric observes that at the same time the incidence of other costs has risen correspondingly from about 50 to 75 per cent. The latter include the cost of mental workers, research, experiment, planning, equipment, heat, power, statistical, and quality control, and capital charges, such as the maintenance and depreciation of machinery and equipment.

The conversion costs other than labour do not increase directly with the volume of production. This is an extremely important feature in mass production, for we have seen that under this system the cost falls mainly into this non-variable section. Thus, given a modern works equipped on the best mass production lines, and the greater the bulk of work the lower will be the cost per unit. Once sufficient volume has been secured to cover the specialisation overheads, we find that the cost of additional production is negligible. It may cost nearly a penny a copy to print a newspaper with a circulation of a million, but if the circulation can be raised to two million the cost per copy may fall to hardly more than a half-penny. The profit comes in the extra output.

Before the Government gave tariff protection to our home industries, the prices at which imported goods were sold in this country were often far below our cost of production. The reason for this was simply that Germany, France, and the United States, being already protectionist countries, had guaranteed home markets which covered costs, and the surplus exported to us represented almost entirely clear profit, no matter at what figure it was sold. With the help of tariffs, our automobile and other industries have been able to build up a production sufficient in volume to justify substantial reductions in domestic prices, and to create an export trade to our Colonies and elsewhere.

The capital necessary for mass production is naturally very large. Accordingly, the manufacturer must be assured of sufficient potential volume of work before his expenditure is incurred, for otherwise loss may result both to the individual and the nation.

If through foreign competition, or for any other reason, the market demand falls below a certain level. the highly specialised works will suffer because of having expensive plant idle. Tariffs serve as the assurance which enables manufacturers to sink money into industries that would otherwise be speculative and unstable.

During the last twenty years, mainly as the result of mass production, prices of manufactured goods have been halved, and the earnings of producers have been nearly doubled.

As Henry Ford, a pioneer of mass production, has observed, machines are doing for men what men could never do for themselves. We may hope that by means of mass production our working-class may also become our leisured class.

Literature.

SHORT NOTICES.

Television, Theory and Practice. By J. H. Reyner. London: Chapman and Hall. 1934. Price 12s 6d.—Those wireless amateurs who are familiar with the work of Mr. J. H. Reyner will know what to expect and welcome this book. The author has a knack of clear exposition and the avoidance of recondite arguments which, even in the most serious of text-books, are uncommonly dry, and which, in a volume obviously intended for the non-specialist would be out of place. He opens with a couple of chapters on the principles of television in which the difficulties of 130-line scanning are very well explained. Then, after a discussion of the part the human eye plays in television, he comes down to practical problems in a series of chapters on Optical Systems, Cathode Ray Television, Film Television, Ultra Short Wave Transmission, Receivers, and so on. There is not one of these chapters which may not be read and enjoyed by anyone who is fairly familiar with the technology of wireless. In a concluding chapter Mr. Reyner discusses the future of television. He recognises its present limitations and foresees the possibility that some day some one may hit on entirely novel methods which will improve the art out of all knowing. "The results," he writes, "which have been obtained in some of the experimental systems not yet made public are such as to inspire enthusiasm into those who see them. . . . With the increased application of the world's brains to the problem, there can be little doubt but that within the next few years we shall have television on at least as satisfactory a scale as the early broadcasting." The book was written months before the recent announcement about the television intentions of the B.B.C. That announcement must have caused many people to desire information about the present condition of the art. They will do well to consult Mr. Reyner's volume.

Pressure Pipe Observations at Punjnad Weir. By Ajudhia Nath Khosla. Paper 162, Punjab Engineering Congress. 1934.—This paper, as its title implies, is mainly a record of observations. Since it was presented, experiments have been carried out with a 1/50 scale model of the Punjnad Weir. The bulk of observations on the prototype have been reproduced on the model to within 2 per cent. Most of the seasonal variations recorded in the paper have been reproduced on the model by a variation in the upstream silt deposit or in the temperature of inflowing water or by a combination of the two. With the subsoil and inflowing water at the same temperature and the upstream and downstream floors free of silt deposit, the pressures obtained from the scale model were exactly the same as those obtained from the electro-dynamic model, more commonly known as the hydro-electro-dynamic analogy. From the close agreement between the results obtained from the two sets of models and between those from the model and the prototype, it appears that, like the flow of electricity, the problem of flow of water through the subsoil is susceptible of mathematical treatment. The pressures in any particular case can be experimentally determined either from the electro-dynamic or the scale model. The experimental work on the 1/50 scale model is being presented as a paper at the February 1935 session of the Punjab Engineering Congress by Harbans Lal Uppal.

BOOKS RECEIVED.

Electricity and Fire Risk. By E. S. Hodges. London Sir Isaac Pitman and Sons, Ltd., Parker-street, W.C.2. Price 10s. 6d. net.

The South American Handbook, 1935. London: Trade and Travel Publications, Ltd., 14, Leadenhall-street, E.C.3. Price 2s. 6d. net.

The Water Jet Pump. By J. E. Gosline and M. P. O'Brian. London: Cambridge University Press, Fetter-lane, E.C.4. Price 1s. 6d. net.

Resistance of Materials. Second edition. By F. B. Seely. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 18s. 6d. net.

Boiler Feed Water. Third edition. By C. G. Jackson, F.I.C. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C.2. Price 6s. net.

The Mercantile Year Book and Directory of Exporters, 1935. London: Lindley Jones and Brother, Ltd., 32, Bishopsgate, E.C.2. Price 20s. net.

The Unified Transport System of the U.S.S.R. By K. N. Iverskoi. London: Victor Gollancz, Ltd., 14, Henrietta-street, W.C.2. Price 3s. 6d. net.

Modern Radio Communication. Vol. I. Fifth edition. By J. H. Reyner. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, W.C.2. Price 5s. net.

Life's Spectrum: Economics, Science, Metaphysics. By W. E. Burnand, M.I.E.E. Sheffield: W. E. Burnand and Son, 66, Shoreham-street. Price 9d. net.

Practical Solution of Torsional Vibration Problems. By W. Ker Wilson, M.Sc. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 25s. net.

The Blue Book, 1935: *The Directory and Handbook of the Electrical and Allied Industries.* London: Benn Brothers, Ltd., 154, Fleet-street, E.C.4. Price 25s. net.

Factory Administration in Practice. By W. J. Hiscox. Second edition by J. R. Price. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 8s. 6d. net.

Standard Gear Book: Working Formulas and Tables in Gear Design. By R. Trautschold. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 18s. net.

Coal: Its Origin, Method of Working and Preparation for Market. Second edition. By F. H. Wilson, M.I. Min. E. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, W.C.2. Price 3s. net.

The Principles of Electric Power Transmission by Alternating Currents. Third edition. By H. Waddicor, B.Sc. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 21s. net.

The Yorkshire, Nottinghamshire and Derbyshire Coalfield: West Yorkshire Area: The Beeston Group of Coals. Upper Beeston Seam, Part I. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2. Price 2s. 6d. net.

Engineering Economics: Works Organisation and Management. Book I, Elements of Industrial Organisation and Management. Third edition. By T. H. Burnham B.Sc. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 8s. 6d. net.

New Harbour Works at Dunkirk.

No. I.

THE port of Dunkirk is now the fourth in order of importance of the ports of France, its trade being greater than that of Bordeaux; Marseilles, Rouen, and Havre alone surpass these in the magnitude of their seaborne traffic. In the following table are set out figures of the tonnage of ships entering and the goods handled in the four principal ports in the years 1929, 1931, and 1932 :—

Year.	Port.	Ships entering. No.	Ships entering. Net reg. tonnage, 1,000 tons.	Exports and imports, 1,000 tons.
1929	Dunkirk	3,740	5,798	5,401
1931	,,	3,234	5,283	4,781
1932	,,	2,728	4,464	4,164
1929	Havre	8,089	9,296	5,472
1931	,,	8,615	9,634	4,506
1932	,,	8,679	10,088	3,936
1929	Rouen	4,441	4,552	9,486
1931	,,	4,185	4,491	8,800
1932	,,	4,375	4,427	8,093
1929	Marseilles	8,309	15,059	9,151
1931	,,	8,448	15,961	8,685
1932	,,	9,099	15,627	8,321

The tonnage of goods imported and exported in 1931 at Dunkirk is equivalent to 578 tons per lineal metre of berthing space and 610 tons per lineal metre of quayage available for traffic.

The seaborne trade of Dunkirk has more than doubled since the year 1913. In 1914 Darse No. 5, at the western end of the series of closed docks which then comprised the principal quayage of the port (Fig. 5), had just been completed, but its quays had not been equipped for traffic. Dunkirk, in common with the other northern ports of France, was made use of by the British Army throughout the war, and Darse No. 5 became in 1917 one of the terminals in France of the wartime train ferry service. After the war, the equipment of the port was completely remodelled, and towards the end of 1919 parliamentary authority was obtained for a large programme of port extensions which will, when they are completed, occupy the site of the ancient fortifications and the sand dunes extending westward from the old entrance channel towards Mardick. The plan of the port, reproduced in Fig. 5, shows the docks and the harbour approaches as they existed in 1920 before the new port extensions were begun. Practically the whole of the maritime trade of Dunkirk is carried on in closed docks, the principal entrance to which is at present the Tristram Lock, completed a few years before the outbreak of war.

The tidal range at ordinary spring tides at Dunkirk is 5·45 m. The following are some of the tidal levels which will be found useful in studying the plans and drawings which we reproduce. All levels are referred to chart datum, which is 0·45 m. below M.L.W.S.T.

	Height in metres above chart datum.
High water of equinoctial spring tides	7·15
Mean high water of spring tides	5·9
Mean high water of neap tides	4·9
Low water of neap tides	1·7
Mean low water of spring tides	0·45
Low water of equinoctial spring tides	0·3
Zero of marine chart	0·0

The flood tide at its maximum has a direction from N.E. or E.N.E. to S.W. or W.S.W. Its velocity at spring tides reaches a maximum of about 4½ knots. The ebb tide running from between west and south-west reaches at times a maximum stream rate of about 4 knots. The old outer harbour was approached through a dredged channel between two jetties almost parallel in plan, the entrance facing north-west.

Plan of Extensions.

The programme sanctioned in 1919 includes the following works :—

(1) A new outer harbour and deep-water entrance.

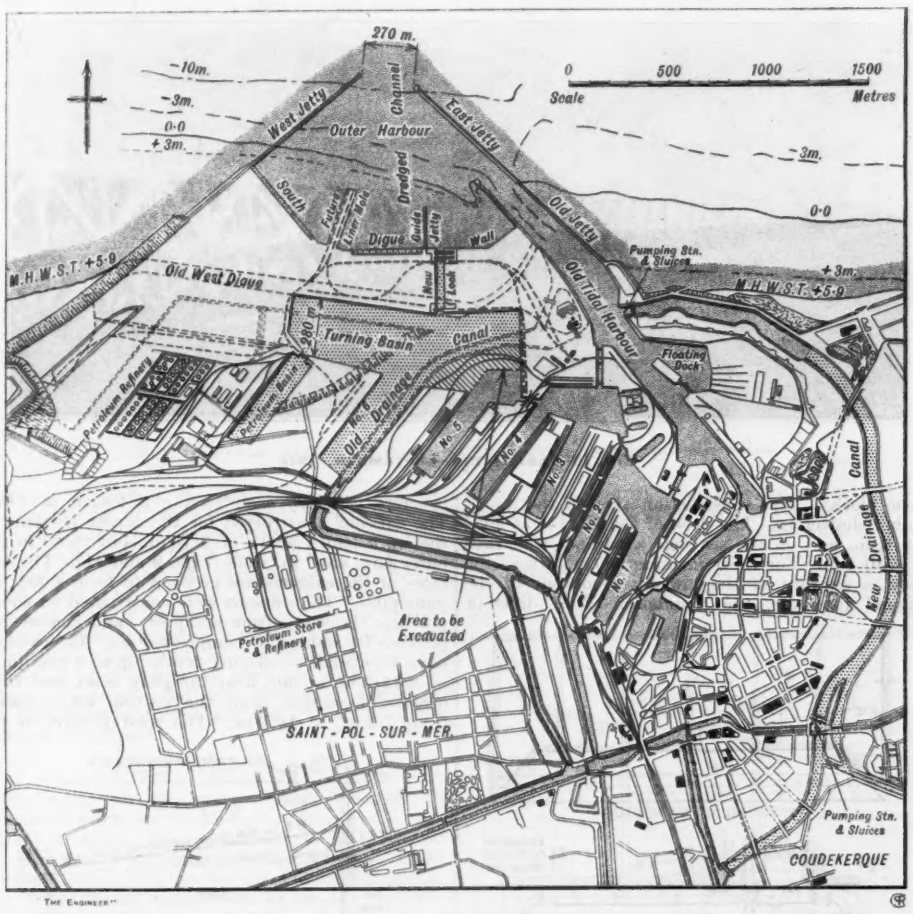


FIG. 5—THE PORT OF DUNKIRK

(2) An embarkation mole in the tidal harbour for passenger traffic and ships calling at the port.

(3) A new entrance lock giving access to a new dock (No. 6), a large turning basin, and a petroleum basin.

(4) A floating dock of 20,000 tons lifting capacity and dredged berth therefor.

(5) The construction to the east of the town of a new canal to provide for inland waterway drainage.

The entrance to the tidal harbour has, in the planning of the port extensions, been considerably modified. The entrance to the old access channel faces north-west, *i.e.*, towards the direction of the prevailing or westerly winds. The new outer harbour is enclosed and protected by a prolongation of the old entrance jetty on the east side of the access channel and a new west jetty thrown out from the sand dunes at a point about 2000 m. west of the old harbour entrance and aligned in a direction south-west and north-east. These two jetties converge, leaving an opening 270 m. wide between the pierheads (Fig. 5). The outer harbour thus formed will have a mean width of over 1000 m., and a length from the west pierhead to the face of the reclamation wall at the new entrance lock of about 950 m. The harbour entrance, instead of facing north-west as formerly, will open on a line approximately N.N.E. The pierheads are situated on a contour of the sea bed 8 m. below chart zero. A wide channel is now being dredged from outside the harbour entrance to the new lock, which is described hereunder. This channel which is dredged through sand, will be maintained at a level of 7·0 m. below chart zero. The sea bed, as well as the land formation in the neighbourhood of the new works, consists of fine sand extending to a considerable depth, merging at lower levels into a

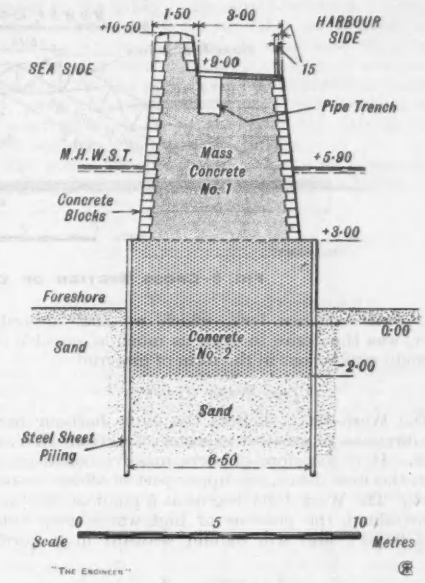


FIG. 6—CROSS SECTION OF WEST JETTY

sandy silt. At or about the level —22·0 is a thin stratum of clay, followed by sand. These deposits are underlaid by compact clay, which occurs at levels between —25·0 m. and —26·0 m., and extends to a great depth. Borings sunk to —60·0 m are in the clay.

Dunkirk Roads.

Dunkirk Roads, an anchorage with depths of from 10 m. to 20 m. at lowest tides, extends east and west of the harbour entrance parallel with the shore. The anchorage is everywhere sheltered by outlying shoals, which also afford a considerable measure of protection to the harbour entrance and the jetties. The latter are in consequence not exposed to relatively heavy seas. The Flemish Banks, which shelter the Dunkirk Roads, extend from Gravelines to the Belgian frontier, the anchorage having a length of about 20 kiloms. and a width of about 2 kiloms.

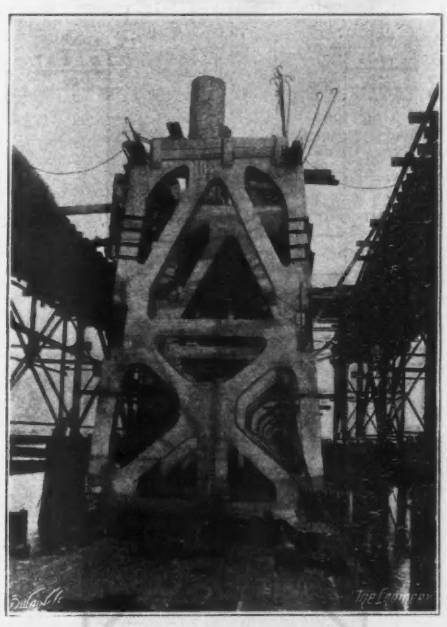


FIG. 7—EAST JETTY SUPERSTRUCTURE AND STAGING

The New Works.

The new works at Dunkirk are of special interest, not only on account of the nature of the ground in which they have been constructed, but also because interlocked steel sheet piling of heavy section has been employed in the building of the lock and other works on a scale which has never been realised in this country, and has, we believe, been equalled abroad only at Bremerhaven. Excavation to a great depth in permeable dune sand, saturated with water a few

feet below the surface, was simplified and made relatively easy by the employment of a large number of tube wells and submersible pumps, by means of which the water table in the soil was lowered below the plane of excavation. Steel sheet piling was employed not only on a large scale for temporary works, but also in permanent construction. One reason for the selection of steel-pile construction for the sides of the great entrance lock, which we shall describe later, was the desire to draw as much as possible on German reparations in the form of material.

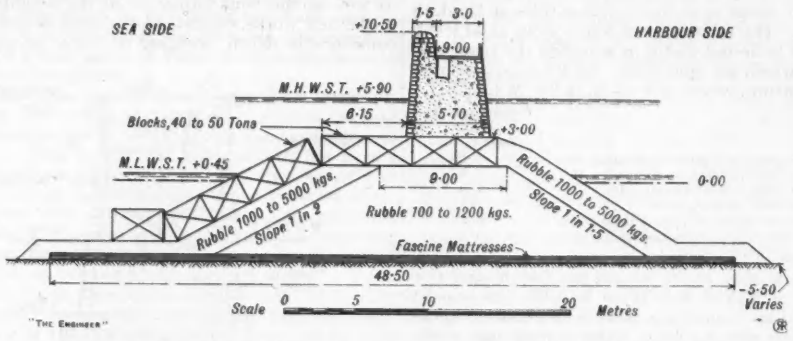


FIG. 8—CROSS SECTION OF OUTER PORTION OF WEST JETTY

THE WEST JETTY.

The West Jetty shelters the outer harbour from the direction of greatest exposure, *i.e.*, from N.W. to west. It is therefore of more massive construction than the East Jetty, the upper part of which is open work. The West Jetty begins at a point on the foreshore about the contour of high-water neap tides (+4·90 m.), and will extend seaward in a north-easterly direction for a total distance (inclusive of the paved slope mentioned hereunder) of 1196 m. The gap between the beginning of the jetty and the old west digue or sea wall, which protects the country from the sea between Mardick and Dunkirk, is filled by an extension of the digue seaward, on a line having the same direction as the jetty, for a distance of about 550 m. The total length of new work is therefore about 1746 m.

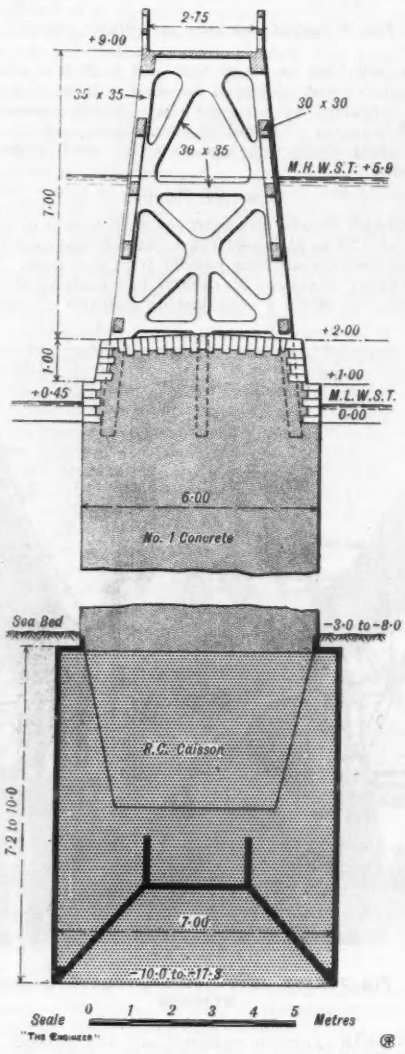


FIG. 9—EAST JETTY EXTENSION—TYPICAL CROSS SECTION

The first section of the jetty, 446 m. long, consists of a paved slope which is backed by material dredged from the outer harbour to form the reclaimed area (Fig. 5). This digue or embankment is similar in construction to that on the south-west side of the outer harbour described in a subsequent paragraph, except that it is surmounted by a wave-breaker or parapet wall of concrete 1 m. in height. For a distance of 250 m. seaward of the end of the embankment and reclaimed area the jetty superstructure is founded on a mass concrete foundation placed between two lines of steel sheet piling, 6·5 m. apart, connected by steel tie rods. The excavation of sand preparatory to the placing of the concrete between the two rows of piling was done by sand pumps. The concrete base and steel piling are finished off at level +3·0 m. On this foundation is built the jetty superstructure (Fig. 6) consisting of mass concrete deposited between two face walls of artificial stone blocks. This construction avoided the use of timber shuttering. The deck of the jetty is at level +9·0 m., and on the sea face a parapet wall rises to +10·5 m. For the remaining 500 m., where the jetty is seaward of the low-water contour of the original foreshore, the foundation is of different design. The superstructure above the level +3·0 m. is exactly similar to that of the inner portion of the jetty, but the substructure is a mound of rubble stone and concrete blocks (Fig. 8). In order to reduce to a minimum the sinking of the mound in the sand of the sea bed, the Dutch method of fascine mattress work was adopted. Mattresses are sunk on the sea bed by weighting with stones and, when in position, the rubble foundation is deposited on them from hopper barges. The mattresses, of varying dimensions, are constructed on the foreshore in the old tidal harbour and afterwards floated to the site of the jetty as required. A view of one of the mattresses in course of construction on the foreshore in the inner harbour is reproduced in Fig. 3, page 276. The stones forming the hearting of the mound are of weights from 100 kilos. up to 1200 kilos. The talus on the harbour side is of stones up to 5000 kilos. weight. On the sea side a similar talus is formed of large stones, but this, as well as the top of the mound, is faced with concrete blocks of 45 tons to 50 tons weight deposited by a floating crane (Fig. 2). The jetty head will be in a depth of water of 8·5 m. below zero. At the present time (December, 1934) the foundations and rubble mound of the West Jetty have been completed up to the jetty head, and it is expected that the superstructure will be finished about the end of 1935. A view of the West Jetty, showing the junction between the paved slope and the vertical superstructure, is reproduced in Fig. 1.

In the construction of the West Jetty 37,600 square metres of fascine mattresses will be used in the foundations; the foundation mound requires 190,000 tons of stone and 25,000 cubic metres of 50-ton concrete blocks.

THE EAST JETTY.

The new East Jetty is an extension, 700 m. in length, of the previously existing structure which shelters the old entrance channel from the north-east. The foundation consists of thirty-nine reinforced

FIG. 10—EAST JETTY—SEPTEMBER, 1934

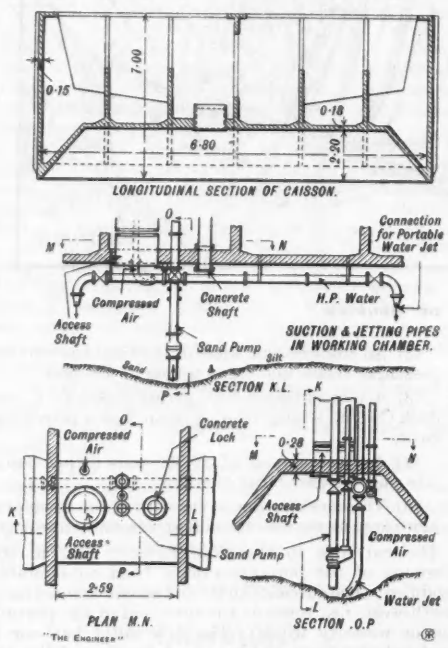


FIG. 11—EAST JETTY—SECTION OF CAISSON AND DETAILS OF PUMPS, ETC.

concrete caissons, each having a length of 17 m. The caissons constructed for the earlier portions of the work had a width of 5·75 m., but those in the outer part are 7 m. wide (Figs. 9 and 11). The end faces of the caissons are grooved to form a key for joint piles. The caissons were constructed on shore, put into the water from a slipway, and floated into position for sinking by compressed air. The caissons have been sunk to varying depths up to a maximum of −17·3 m. at and near the jetty head, and their heights, measured from the cutting edge, varied from 7·2 m. to 10·0 m. The solid portion of the superstructure of the jetty is of mass concrete, the lower part being placed inside shuttering while the upper part is faced with artificial stone block work, as in the West Jetty. The solid work is brought up to level +2·0 m., or just above low water of neap tides. Above that level the superstructure is of open reinforced concrete work. All the framed trestles are precast work, and were made on shore, and assembled on the jetty, where the longitudinals and bracings were poured *in situ* in steel-faced forms. The reinforced concrete trestles rise to a level of +9·0 m., and carry a footway 2·75 m. wide. Temporary staging was employed in the sinking of the caissons and building the superstructure of the jetty.

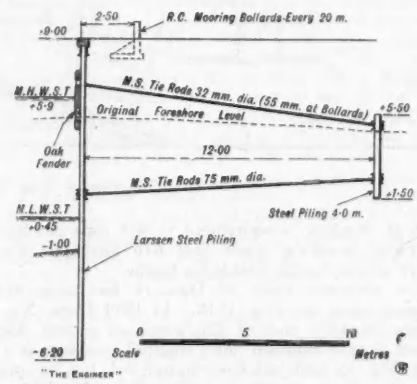


FIG. 12—CROSS SECTION OF QUAY WALL IN OUTER HARBOUR

The staging was of steel and timber construction erected on either side of the permanent work as seen in the views, Figs. 7 and 4, page 276. It supported rail tracks on which travelled a goliath crane by means of which the air locks, &c., were placed in position on and removed from the caissons, and the precast concrete work erected in the superstructure. This staging

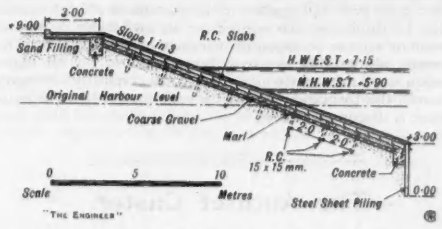


FIG. 13—SOUTH AND WEST DIGUES—TYPICAL SECTION

facilitated the accurate placing and sinking of the caissons as well as the building of the superstructure after sinking had been carried out. As successive lengths of superstructure were completed to deck level and became available to carry construction roads, portions of the temporary staging alongside were removed and re-used farther out in the work (Fig. 7). A view of the last caisson, that forming the foundation of the jetty head, being placed in position between the temporary stages on April 11th, 1934, is reproduced in Fig. 4, page 276. The building of the East Jetty was completed in August, 1934; a view of the finished work is seen in Fig. 10. The sinking of the thirty-nine caissons involved the excavation of 48,600 cubic metres of material and the placing of 6400 cubic metres of concrete in compressed air. The solid superstructure contains 61,500 cubic metres of concrete and artificial stones, and there are 1000 cubic metres of reinforced concrete in the open superstructure.

FIG. 14—PAVED SLOPE OF RECLAMATION BANK IN OUTER HARBOUR

COMPRESSED AIR WORKING.

The strata through which it was necessary to sink the caissons for the East Jetty consisted of silt, shelley sand, and thin lenticular beds of clay. At the level of the foundations of the work the strata is entirely sand. The method adopted for the excavation done under compressed air in the working chamber was as follows.

The workmen disintegrated the soil by high-pressure portable water jets served by a 40 h.p., nine-stage, centrifugal pump having an output of 100 cubic metres per hour under 60 m. of water pressure. The mixture of water and silt or sand flowed towards the centre of the caisson, where a fixed water jet kept the material in a state of suspension while it was being pumped—Fig. 11. The evacuation of the liquid mixture was done at the rate of 100 to 120 cubic metres of soil per twenty-four hours, the proportion of sand to water reaching a maximum of 24 per cent. It was possible to carry out some part of the excavation inside the chamber automatically by means of a centrally placed high-pressure jet and the excavating pump before it was necessary to put workmen into the compressed air chamber. The caisson for the foundation of the jetty head which is 8·5 m. wide, was sunk mainly automatically by jetting and pumping controlled externally, the number of hours that men had to work under compressed air in this caisson being thereby reduced to a minimum.

RECLAMATION WALLS.

The reclaimed area on the south side of the new outer harbour lies between the seaward face of the old stone-pitched digue and the new walls which form the southern limit of the water space of the harbour. The new entrance lock is situated near the eastern end of the reclaimed area, and, between its outer end and the old west entrance jetty there is a wall constructed of steel interlocked sheet piling with a vertical face (Fig. 12) alongside which vessels will be able to lie afloat at high water. The piles are 15·2 m. in length and are tied back by two horizontal rows of steel tie-rods to an anchor curtain, 4 m. deep, of steel piling driven 12 m. behind the face of the wall. The harbour bed in front of the wall is being dredged to the level —1·0 m. or lower. Oak fenders are bolted to the steel piling at intervals.

On the west side of the entrance lock the reclamation wall takes the form of a paved slope or digue, except in the neighbourhood of the guide or lay-by jetty at the lock, described below, and of the future berthing mole where the walling is of the vertical design described above. A section of the digue wall is shown in Fig. 13. The face has a slope of 1 in 3, and its top is at level +9·0 m. The toe of the wall is formed of steel sheet piling driven to a depth of 3·0 m. below the foot of the paving. The piling was driven with detachable lengths extending to above high-water level to form a temporary cofferdam behind which the excavation in the foreshore and the construction of the revetment were carried on (Fig. 14). The toe piling is backed with mass concrete. The paving consists of precast reinforced concrete slabs, 10 cm. thick, laid on a bed of coarse gravel, 15 cm. thick, under which is 15 cm. of puddle clay. At intervals of 2·0 m. both ways small pins or piles, 15 cm. square, of reinforced concrete, are driven into the foreshore or filling material. These support reinforced concrete ribs laid in the direction of the slope and cast *in situ*, the steel reinforcement of the ribs being linked to that of the pins. The concrete

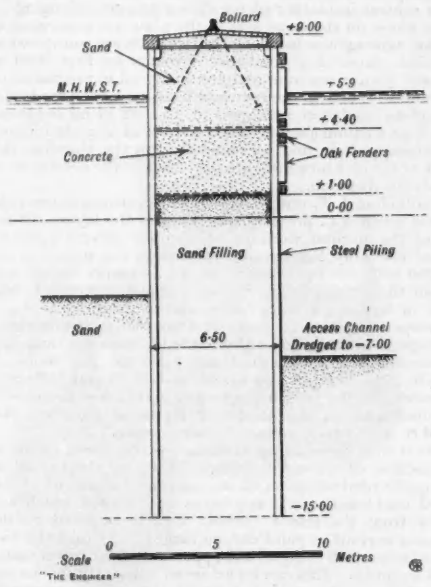


FIG. 15—CROSS-SECTION OF JETTY AT ENTRANCE LOCK

slabs are jointed on all edges, their transverse edges resting on ledges formed in the ribs.

The reclaimed area between the old entrance channel, the south reclamation wall, and the West Jetty has been filled to the level of +9·0 m., the requisite material—about 2,000,000 cubic metres—being excavated by a suction dredger from the site of the new lock, the future turning basin of Darses Nos. V and VI, and the petroleum basin. The whole of the material was pumped to the place of deposit.

JETTY AT ENTRANCE LOCK.

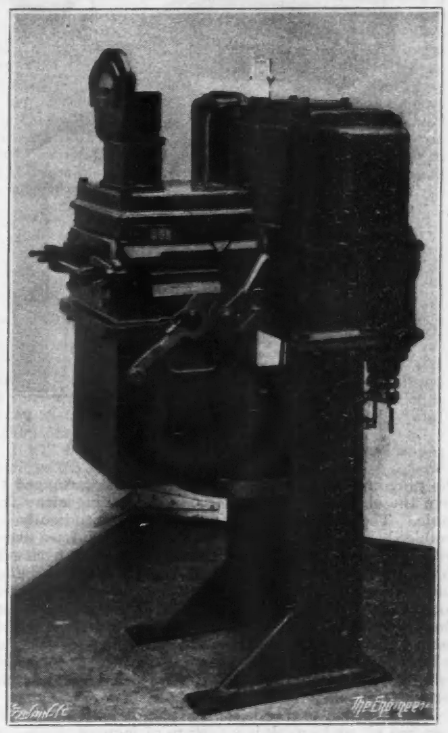
On the west side of the lock entrance is a guide or "lay-by" jetty built on a line parallel with the centre line of the lock. This structure is 200 m. long, and is aligned 60 m. west of the centre line of the lock. It consists of two walls of interlocked steel sheet piling driven to —15·0 m. and spaced 6·5 m. apart (Fig. 15), connected together by three rows of tie-rods, those in the lowest row being at level +1·0 m. and welded to the piling. The space between the piling from the level +1·0 m. to +4·4 m. is filled with concrete; above +4·4 m. there is sand filling and a paving of granite setts with copings of reinforced concrete. On the side adjoining the entrance channel the jetty is protected by heavy oak fenders, and at intervals along the centre line of the jetty are cast steel bollards set in concrete blocks.

The access channel to the lock is now in course of being dredged to —7·0 m. over a width of 150 m.

(To be continued.)

Pillar Type Switchgear.

IN addition to minor detail improvements in Reyrolle metal-clad pillar type switchgear, as shown in the accompanying illustrations, two features to which the makers now attach particular importance are the use of detachable cable-dividing boxes and a self-contained earthing switch. Before considering these features in detail, however, it may be explained for the benefit of those who are unaware of the fact that the gear is dust, damp, and vermin proof and is simple to maintain. Although primarily intended for mining and industrial service, it is now used in small sub-stations and kiosks, for which it is particularly suitable on account of its compactness. It complies with the British Government's Regulations for factories and mines and has been certified flame-proof by the Mines Department at Buxton. The pillars are self-contained and may be used as single units, or a number may be assembled to form a complete switchboard. They consist of two main portions—the fixed portion including a bus-bar chamber, a plug-in



PILLAR SWITCH UNIT

chamber and connectors, and the removable portion, including an oil-immersed circuit breaker, current transformers, and the operating mechanism. All routine inspection, adjustment, and maintenance can be carried out in perfect safety on site or in the workshop after the removable portion has been withdrawn.

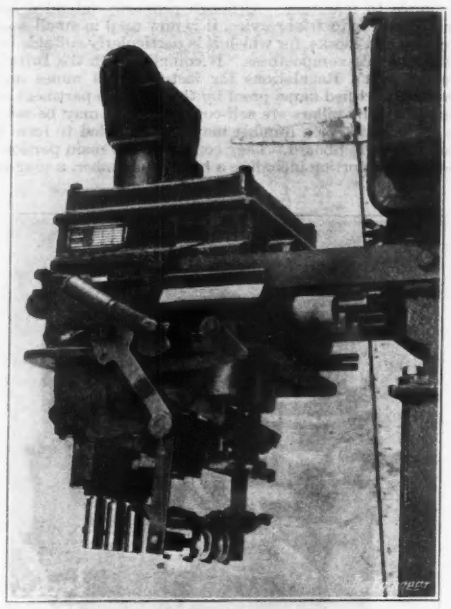
The fixed portion is composed of cast iron or welded steel and consists of a pedestal supporting the cable dividing box and a plug-in chamber with the bus-bar chamber, which is filled with compound, mounted above it. Two heavy steel rails carry the circuit breaker and act as guides, while it is being withdrawn or plugged in. When the circuit breaker is withdrawn the plug-in receptacles are the only accessible live parts and are deeply recessed in porcelain insulators to prevent accidental contact. A lock-off door is also provided, so that the plug receptacles can be entirely covered. The oil-immersed circuit breaker is of the trip free type with the on and off positions clearly indicated.

Over-current protection is usually obtained by means of series trip coils or trip magnets, and adjustment is provided to enable the tripping current to be varied from the normal rating of the trip coil or magnet up to three times that value. Normally operation is instantaneous, but a time lag can be obtained by fitting inverse time limit dashpots

to prevent tripping on momentary surges. Alternatively over-current protection can be provided by means of current transformer-operated trip coils. Under-voltage releases can be fitted and when a panel is required to control a motor circuit facilities are provided for interlocking it with the motor starter panel. Core balance leakage protection can also be fitted to circuit breakers to trip with earth currents as low as 5 per cent. of the rating of the core balance transformer.

As all the tripping mechanisms are immersed in oil contained in the circuit breaker tank, maintenance is reduced to a minimum and a high degree of reliability is ensured. Each pillar is equipped with safety and simple interlocks which prevent plugging in or withdrawing the removable portion when the circuit breaker is closed and all other incorrect operations. In addition to these standard interlocks, other special mechanism can be fitted to ensure correct performance of any particular duty. On account of its metal-clad construction the gear can be handled with safety under normal conditions, but special safety devices are provided to protect men working on feeders controlled by it.

The voltmeters and ammeters normally fitted to these switch pillars are of the dead-beat moving iron spring-controlled type, with 5in. protected dials; but, if specified, flame-proof instruments are supplied with wide flanged joints and wire reinforced glass fronts. When the voltage does not exceed 600, the voltmeters are connected to the supply through fuses, but for higher voltages potential transformers are used. Ammeters are fed by current transformers contained in the circuit breaker hoods. To avoid the difficulty of filling bus-bar chambers with compound below ground or in other inconvenient situations, link chambers with removable links can be provided to fit between adjacent panels of a switchboard, and this enables the bus-bar chambers to be filled in the factory or in a workshop on site. Dividing boxes can be fitted below or behind the plug-in chamber and at the end or above the bus-bar chamber. On dwarf switchgear the box is always fitted at the back of the pillar. When the position behind



Earthing Switch

the plug-in chamber is used the box can be arranged to give the choice of eight directions for leading away the cable. The dividing boxes are split longitudinally to enable them to be clamped over the cables and are fitted with suitable glands. An additional clamping ring is fitted for wire armoured cables. When frequent coupling and uncoupling of the feeder cable is necessary detachable compound-filled flit-plug dividing boxes, as mentioned at the outset, are fitted. The use of these boxes makes it unnecessary to unseal the cable ends each time a connection is broken. Extension lengths can be inserted in the cable run with a minimum amount of work below ground, and temporary cable joints are eliminated.

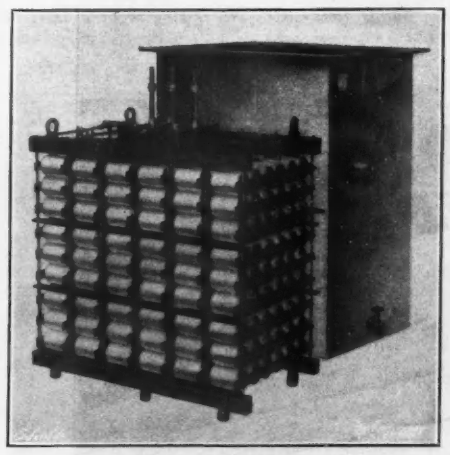
The provision of means for earthing a feeder on which men are about to work is a feature of increasing importance, and it is required by the Coal Mines Act, 1911, that "adequate protection shall be taken by earthing or other suitable means to discharge electrically any conductor or apparatus or any adjacent apparatus if there is danger therefrom before it is handled and to prevent any conductor or apparatus from being accidentally or inadvertently electrically charged when persons are working thereon." The switchgear under consideration allows an outgoing feeder to be earthed either by the use of extension contacts fitted to one set of the circuit breaker plug-in contacts, and arranged so that the feeder earthing circuit is completed by closing the circuit breaker, or alternatively by fitting an earthing switch, as illustrated, as an integral part of the circuit breaker. Either of these earthing devices is safe to operate and padlocks may be fitted to ensure that the handle is not moved inadvertently. One of the illustrations shows the tank switch removed and the earthing switch handle padlocked in the "on" position.

As the earthing switch handle, which is conspicuously coloured in red, is interlocked with the circuit breaker handle to ensure correct operation, the earthing operation is easy, quick, and safe. Other advantages are that the switch completes the circuit rapidly under oil and the switch is capable of closing on a fault equivalent to the kVA rating of the circuit breaker. There is no loose apparatus and ease of operation encourages the use of the earthing switch. Pillar type switchgear, as described, is made in four types, designated F, E, E1, and E2, the respective ratings being 200 ampères at 3300 volts, 400 ampères at 3300 volts, 200 ampères at 6600 volts, and 600 ampères at 3300 volts.

Static Condensers for Power Factor Correction.

To the list of firms manufacturing static condensers for power factor correction Johnson and Phillips, Ltd., of Charlton, S.E.7, may now be added. They are made under licence to the patents of Emile Haefely and Co., of Basle, Switzerland, for all pressures up to 33 kV, and may therefore be connected directly to high or low-tension systems without special transformers. Severe tests are claimed to ensure the highest possible electrical factor of safety, while the method of manufacture reduces the floor space required to a minimum. The losses are said to be negligible and the temperature rise low. For low-tension work units are supplied from $\frac{1}{4}$ kVAR to 300 kVAR and from 15 kVAR to 1000 kVAR for high-tension service. In the rare event of an element having to be changed the work can be carried out in twenty to thirty minutes. Owing to the simple form of construction, which does not involve riveting, welding, or soldering, condensers can be supplied to suit individual requirements at short notice. The form of construction is also claimed to eliminate sources of possible faults.

The condensers consist of a group of elements each designed for a reactive load of about $\frac{1}{2}$ to $\frac{3}{4}$ kVAR. Each element consists of two continuous metal foil bands separated by layers of specially prepared insulating paper, which is wound together with the metal foil into a cylinder



Static Condenser

on a central insulating tube which projects beyond the ends of the element. To suitably shaped slotted metal ferrules on the projecting ends the metal foil bands are connected. For low-tension work the requisite number of condenser elements is assembled in parallel groups, as shown in the accompanying illustration, the elements being designed to slide along metallic bars serving the dual purpose of bus-bars and structural members of the framework. The elements of high-tension condensers are assembled in series parallel groups according to the voltage and total capacitance required. The groups of elements forming the three-phase banks are arranged on either side of a central insulating plate. The elements belonging to each phase on the same side of the plate are connected in series, whilst phase banks on the two sides are connected in parallel. Individual condenser elements are first dried in air and then in vacuum and are finally oil impregnated in vacuum. When all the requisite tests have been made the complete condenser immersed in its tank of oil is placed in a high vacuum chamber for a number of hours to remove all entrapped air, and on removal from the chamber the tank cover and terminals are fitted, when the condenser is ready for dispatch.

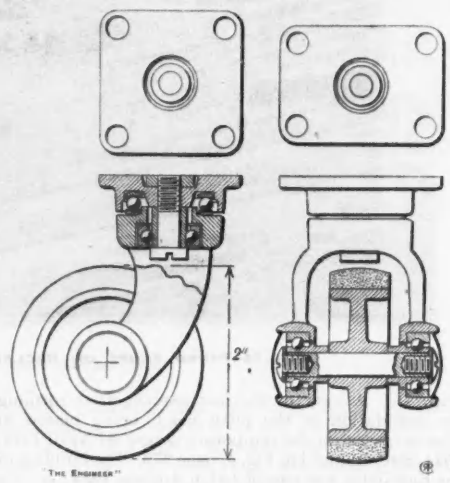
Individual L.T. and H.T. condenser elements are subjected to an A.C. pressure test between the layers of four times the normal working voltage for several seconds. After assembly low-tension condensers for pressures up to 350 volts are subjected to an A.C. pressure of two and a-half times the working voltage for one minute. In the case of L.T. condensers for pressures above 350 volts a corresponding test is made at three times the working voltage. An A.C. test is also made between the tank and condenser layers in accordance with the provisions of B.S.S. 171—1927, Clause 41, on both H.T. and L.T. condensers. In the case of the former a D.C. test pressure is applied between the condenser layers of six times the R.M.S. A.C. service voltage for one minute.

As is well known, improvements of the power factor of a machine or system is brought about by the partial or complete neutralisation of the lagging component of the total load current. If apparatus be installed which will draw from the line a current directly opposed to the lagging current, a point can be reached at which the two components will be equal and opposite and the power factor will be unity. This can be achieved efficiently by the use of a static condenser, but in practice there is an economic limit, beyond which it is not economically sound to go, the limit usually being in the neighbourhood of 0·95. Methods of determining the condenser kVAR required to raise the power factor of a machine or system from a given value to a given higher value have been described in our columns, and the matter is also dealt with in a clear and concise way in a publication issued by Johnson and Phillips, Ltd.

To relieve all current carrying parts as far distant from the power station as possible it is, of course, essential to place the condenser as near as possible to the inductive load. Broadly, the desired power factor correction can be achieved either by connecting condensers directly across the terminals of individual machines, transformers, &c., or across the nearest distribution board controlling a group of machines, &c. In the former case the condensers are under the control of the motor or transformer switches, and on switching the power plant out of circuit the condensers discharge themselves through the windings of the motors or transformers. For group control, however, a separate switch is necessary, and when the current does not exceed 100 ampères it may take the form of a quick-break knife switch, together with resistances of high ohmic value to discharge the condenser on switching it out of circuit or on the occasion of a failure of the supply. For currents above 100 ampères, however, and for all high-tension work automatic oil switches are generally arranged to earth the terminals through a resistance when the condenser is disconnected.

The Autoset Castor.

We recently inspected at the offices of Mr. J. F. Atkinson, 14, New Bridge-street, E.C.4, an improved type of ball-bearing castor known as the "Autoset." The drawing of the smallest pattern of the castor, given herewith, shows that each of the moving parts rotates on ball bearings, giving freedom of movement and silence in action with a minimum of friction. The wheel is rigidly fixed to the axle, which runs in ball races in the forks, thus avoiding a trouble frequently experienced with loose wheel castors owing to the picking up of threads, fluff, &c., from the floor causing the wheel to bind on the shaft. In the smaller type of castor the bearings in the forks are protected by a dust cap, held by a spring clip, which can be removed for lubricating purposes; but we noticed that on the larger models grease gun nipples are fitted. In the larger castors with 6in. and 8in. diameter wheels the destructive action of bumpy floors upon both castors and trucks is considerably reduced by what is called an equaliser. The head of the castor is connected to the lower part by a horizontal spindle passing through a stout spring, the ends of which are fastened to the head and crown of the forks. This spring has a damping effect on sudden jars caused by the

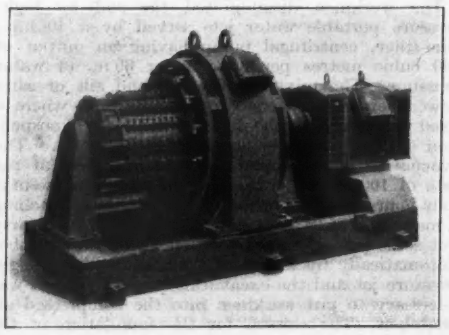


The Autoset Castor

wheel passing over ridges. "Autoset" castors are supplied with either the flat or spindle type of head, and rubber-treaded wheels are supplied as a standard, although other types are available. We tried several types and sizes of castor and observed their smoothness of action and robust design.

Shunt Phase Advancers.

For many industrial electric drives the starting and overload torque conditions make it essential to employ an induction motor which can be made to operate at high

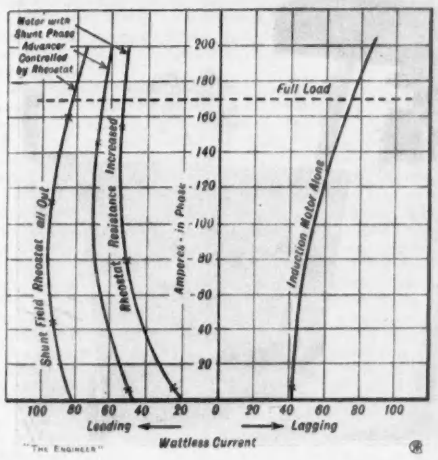


Shunt Phase Advancer

power factor, with the aid of a phase advancer, which generates a low-frequency A.C. voltage. The B.T.H. shunt-phase advancer is not, of course, new, but the latest characteristic curves obtained with a 1250 h.p., 3000-volt induction motor and large phase advancer of this type are not without interest. The wattless current remains practically constant at all loads, and can be varied in a simple and efficient manner by means of a shunt field rheostat,

just as in the case of a synchronous motor with a shunt excited direct-current exciter. Sparkless commutation of the phase advancer is said to be obtained under all operating conditions. Brush wear is therefore negligible, even when the induction motor is employed for driving rolling mills, giving rise to peak loads several times the full load value. The phase advancer illustrated carries 1553 ampères per phase, and is used in conjunction with a 3500 h.p. rolling mill motor. Apart from raising the power factor, it also has the effect of increasing the motor's overload capacity. Unlike phase advancers without shunt excitation, it is unnecessary to open the rotor circuit of the induction motor when putting the phase advancer into service, a feature claimed to be of considerable importance in the case of motors capable of developing several hundred horse-power.

When an induction motor is designed for operation in

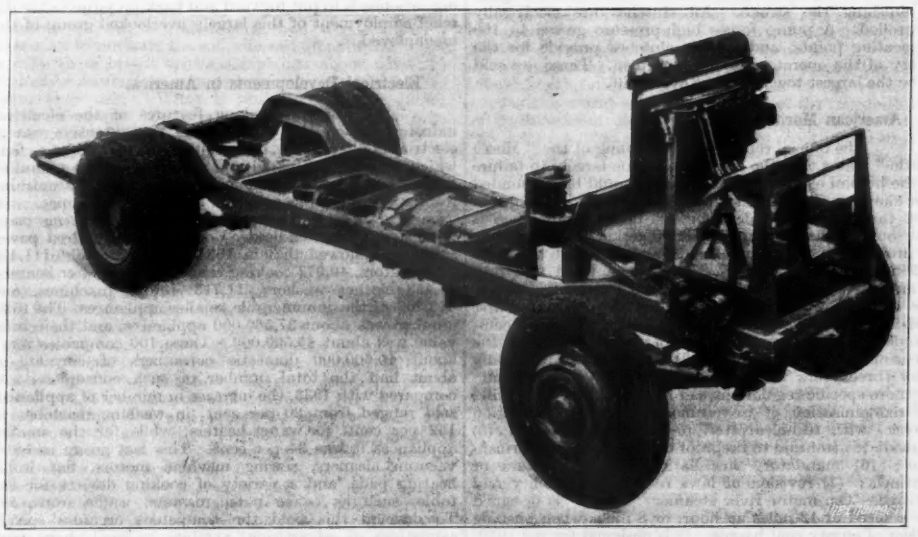


CHARACTERISTICS OF 1250 H.P. 3000-VOLT MOTOR

conjunction with a phase advancer at unity power factor, a very high efficiency can be obtained. Tests on a 1100 h.p., 6600-volt motor with a shunt phase advancer indicated that an efficiency of no less than 96·6 per cent. was obtained at unity power factor. When a shunt phase advancer is added to an existing induction motor, the cost of power factor correction is claimed to be very low, as compared with that of other methods, and in the case of a 250 h.p. installation it is said that the total cost of the equipment was saved in four months. Not only is the action of the B.T.H. advancer analogous to that of a direct-current shunt-excited generator, but the control of the commutation and characteristics of the motor is equal to that of the D.C. exciter of a synchronous machine.

Light-Weight Trollybus Chassis.

THE illustration shows a lightweight trollybus chassis produced by Ransomes, Sims and Jefferies, Ltd., of Ipswich. It is smaller than the standard vehicle, and has been designed specially to meet the requirements of the Municipality of Georgetown, Penang. The chassis is built to take a twenty-four-seater saloon body with rear entrance. The overall dimensions are as follows:—Length, 21ft. 7in.; width, 7ft. 2in., and the turning circle, 47ft. over the complete bus. There are pedal-operated brakes on the front and rear wheels, and a hand brake of the ratchet pattern operating the rear wheels only. Although not equipped with air pressure brakes, good results have been obtained, both from the pedal and manually operated gear, the stopping distance being

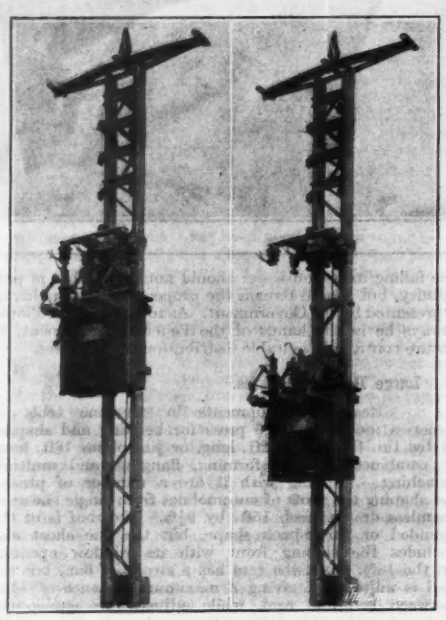


TROLLYBUS CHASSIS FOR GEORGETOWN, PENANG

under 25ft. from 20 m.p.h. when the hand and foot brakes are operated simultaneously. The vehicles are driven by Ransome's 35 b.h.p. series motors, designed for the series field regulated system of control, and of the fabricated type generally similar to the makers' well-known lightweight motor. Insulation is class "B" throughout, and commutation is sparkless at 150 per cent. overload with fully diverted field. In view of the special circumstances in which these buses will operate, it was decided to employ rheostatic braking operated from the same pedal as the usual mechanical foot brake. This arrangement is claimed to be the only effective way in which the full benefits of electric braking can be obtained, and by operating it from the normal brake pedal its use by the driver is rendered compulsory. The control gear is manufactured by Allen West and Co., Ltd. Experience has shown that high speeds in a public service vehicle are of little use where traffic is congested or the stops per mile very frequent, but that high acceleration is of far greater importance. With these principles in mind, the buses have been designed for a top speed of approximately 20 m.p.h., and tests indicate that, as a result, the current consumption is likely to be very low.

Pole Type Sub-stations.

WITH a view to providing a simple method of obtaining a L.T. tee off supply from an existing E.H.T. line, the Better Lines Company, of Mile Oak, Tamworth, has introduced the unit pole type sub-station shown in the accompanying illustrations. A Callender steel pole of the type shown is equipped with E.H.T. and L.T. pedestal type contact insulators and a transformer carrier with lifting and retaining gear. When the transformer

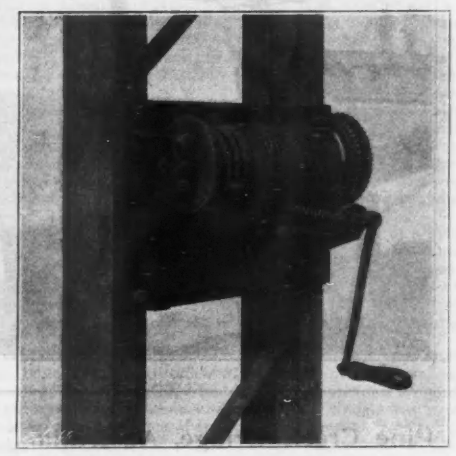


POLE TYPE SUB-STATION

is lowered both the E.H.T. and L.T. circuits are positively disconnected, and external fuses may be replaced at ground level with perfect safety and ease. Two of these sub-stations will shortly be put into service at Cardiff and Oswestry, and many engineers in other parts of this country and abroad are said to be displaying keen interest in them. The whole apparatus, together with the L.T. line, can be erected without shutting off the supply, the three leads to the E.H.T. line being connected up when everything is ready for the supply to be switched on.

The operation of changing transformers as the load increases from 5 to 100 kVA, can be carried out with the main circuit in operation, while the elimination of separate E.H.T. and L.T. switches and fuses which involve a multiplication of insulators and connections simplifies the system. The transformer is switched on and off at the E.H.T. contacts, which, like those on the L.T. side, are of a special Butt type. Arcing horns are provided on the E.H.T. side. Simplification of the overhead system by the elimination of H type terminal or switching poles is claimed to facilitate the task of obtaining wayleaves. Duplicate sub-stations of 25 kVA or less can also readily be provided on separate E.H.T. poles, as, for example, at each end of a village or town instead of a single unit upon which the whole load is dependent. A duplicate supply is thus provided to avoid complete shut-downs, and the transformer capacities can be graded to suit the load densities. The voltage regulation of the system is also improved. Economy is effected by the maintenance of supply and the rapidity with which it may be restored at points where a transformer is damaged by atmospheric or other disturbances.

All porcelain associated with the equipment is in compression and slamming actions liable to break insulators are eliminated. If required, the contacts are shrouded by Pernax tubes, and when the contacts are closed the weight of the transformer is taken off the wire ropes. It is impossible for the transformer to travel above its correct position, and audible warning of the completion of the upward travel is given by the sharp snap action of the



SELF-SUSTAINING WINCH

retaining hooks on the carrier. When the transformer is at the ground level the oil can, of course, be changed or the transformer may be lowered into a vehicle and taken away after it has been freed from the carrier by the removal of four bolts. If required, rollers are fitted to the tank base and E.H.T. and L.T. dividing-out boxes may be provided. The capacities of the transformers may range from 5 to 100 kV. A small waterproof sheet held over them whilst changing the external fuses gives complete protection. The self-sustaining winch operates on a double-purchase lift, and little effort is required to retain the load in any position.

BUGLE CALL AND LULLABY.

"IN my address on 'Change or Decay' at the B.E.A. luncheon meeting on January 10th," writes Mr. David Bremner in the *Bulletin of the B.E.A.* for January and February, 1935, "I sounded a bugle call to action, but this was soon followed by the sweeter music of a lullaby in the form of a leading article on 'Quality and Markets' in THE ENGINEER of February 1st.

"I will first clear the ground by saying that I share the views expressed in the article as to the limited extent to which British quality can command a higher price in the severely competitive markets of to-day. The unpleasant truth is that we with our relatively high charges and wages costs, are faced with the difficult problem of increasing our competitive power by reducing our costs of production and our selling prices without sacrificing in essentials the quality which is expected of British manufactures. The facts and considerations concerning quality, standards and price are well known to me, but they were not the subject of my address.

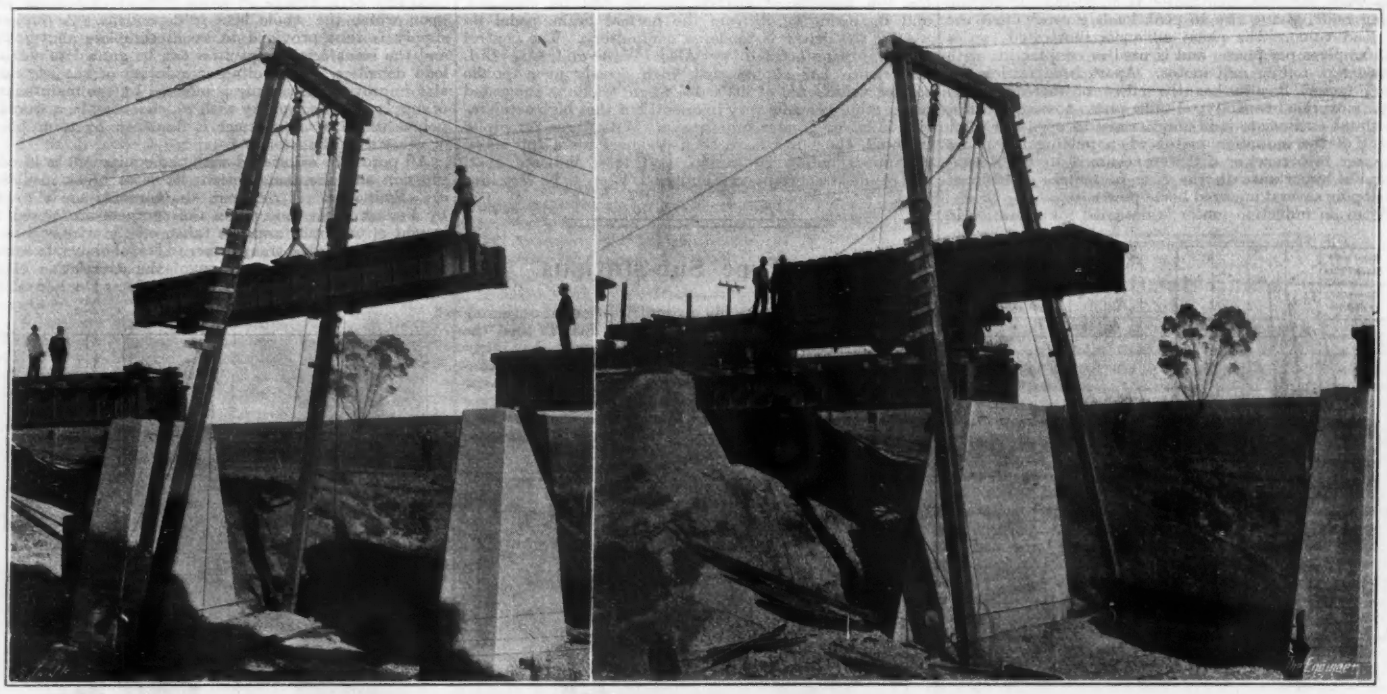
"In criticising some of my remarks THE ENGINEER has confused quality with kind or class of machinery. My advice was not that we should raise the quality and price of the kinds of machinery we now manufacture and export at an average price of £97 per ton, but that we should make more of the kinds of machinery we do not now manufacture, but import at an average price of £176 per ton.

"I am not so foolish as to imagine that we could become completely self sufficient in machinery manufacture, and I realise that there are highly specialised machines, strongly protected by patents, and by dearly bought special experience and skill in their manufacture, which cannot be made at will by anybody in any country; also that in some cases the world demand for some particular machine may be so small that it can be fulfilled by one existing factory. But my remarks were based on big figures which after making all reasonable deductions show that there are big gaps in our machinery manuture which could and should be filled. For evidence of this it is only necessary to refer the reader to Tables 8 and 9 on pages 19 and 20 of this *Bulletin*, and to Table 3 on pages 74 to 76 of the B.E.A. *Bulletin* for May-June, 1934.

"In 1934 we imported machinery to the value of £11,271,249. From the U.S.A. alone we imported to the value of £4,858,657, the average value being £238·6 per ton. These and the other figures to which I have drawn attention are eloquent enough to speak for themselves in support of my case.

"I am sorry that by economising words in one passage of my speech I afforded THE ENGINEER the opportunity of basing a criticism on a misunderstanding of my meaning."

METHOD OF HANDLING GIRDERS IN BRIDGE RECONSTRUCTION



Pine Creek Bridge, Australia.

AMONGST important public works which have been recently carried out by the South Australian Railways (Adelaide) was that of strengthening Pine Creek Bridge, near Hansborough (Roseworthy-Morgan Line), in accordance with a programme to enable heavier locomotives to work on this line. The original bridge consisted of five 32-foot deck steel plate web girder spans, supported on concrete abutments and steel trestle piers, and was able safely to carry 25,000 lb. axle loads. The new bridge was designed for Cooper's E 50 loading, or an axle load of 50,000 lb. New steelwork was fabricated for the three centre spans, and the end spans were strengthened by doubling up the existing girders with those released from the centre spans. The piers were strengthened by encasing the existing trestles in concrete, and the Morgan end abutment, which was unsatisfactory, was repaired by placing additional concrete against its front face.

The method of placing the new superstructure is clearly shown in the accompanying engraving. The steelwork, which was fabricated at Islington, was transported to Hansborough siding on a low railway truck. The bridge timbers were placed on the steelwork while the truck stood in the siding. A timber gantry was erected over the span to be removed. The truck with the new steelwork was brought up to the bridge at the Hansborough end, and an empty similar truck was placed at the other end ready to receive the old span. The lifting of the spans and the tilting of the gantry were done by means of crab winches. The substitution was quickly effected in this way. The maximum weight to be lifted was 12 tons.

American Engineering News.

Irrigation Policy of the United States.

FOR many years the United States Government has been carrying out a policy of reclaiming great areas of arid and semi-arid regions by irrigation and the preparation of the lands for cultivation. But there has been considerable trouble in getting payments from the farmers, while complaints have been made against the general policy and the methods of its administration. The construction cost of the dams, reservoirs, canals, and other works has totalled about £45,700,000, of which £42,000,000 is repayable, while the amount repaid so far is only £11,150,000. All the works and irrigated areas are in the Western States. A commission was appointed some time ago to study the present system, and in its recent report presents the conclusion that Government reclamation of these lands is a sound and desirable undertaking and should be continued as a fundamental agency of national public welfare. It represents a constructive policy of social development. One source of trouble has been that under the law the Bureau of Reclamation, which studies plans, and carries out the projects, with their engineering works, is also the collection agency. It is recommended that this system be changed, so as to relieve the Bureau of this responsibility and transfer it to a banking organisation on the basis of mortgages on the property. As to the areas now settled, they are said to be in general well developed and represent strong, prosperous communities, except for the influence of the present depressed farming conditions. The selection of suitable settlers is giving excellent results, but it is suggested that the Government might expedite settlement by some preparatory work, such as the levelling and seeding of a 10-acre tract on each farm. Some of the larger works include power development by hydro-electric stations, but the commission points out that power production and farming should be considered independently. The right to power inherent in the falling irrigation water should not be granted in perpetuity, but should remain the property of the public, as represented by the Government. As to storage, this should always be in the hands of the Federal Government, to ensure control of equitable distribution of the water.

Large Bending Presses.

Recent developments in machine tools in America include a large press for bending and shaping plates 1in. thick and 12ft. long, or ¾in. plates 18ft. long. It combines bending, forming, flanging, and multiple punching. Ranking with it are a number of presses for shaping the roofs of automobiles from single sheets of seamless drawn steel, 15ft. by 9½ft. The roof is of the rounded or turtle-back shape, but the one sheet also includes the sloping front with its window opening. In the 18ft. press, the ram has a stroke of 6in., but the bed is adjustable, giving a maximum distance of 14in. between bed and ram, while adjustments enable the distance to be varied, to suit conical work. Two speeds are provided, for five or twenty strokes per minute. Working loads may be developed up to 1000 tons, an indicator showing and recording the pressures during operation. The clutch is of the hydraulic type, electrically controlled by push-buttons arranged at convenient positions. The steel fly-wheel, 4½ft. in diameter, weighs nearly 2 tons, and is driven at 600 revolutions through V belts from a 50 h.p. motor. The automobile roof presses also develop working pressures up to 1000 tons. A single stroke replaces the two operations formerly necessary, and leaves the sheet with such a smooth mirror-like finish as to eliminate many of the grinding and polishing operations formerly required. The slides holding the sheet have strokes of 10in. to 26in., but owing to the operating speed of six strokes per minute being too high for uniform flow of metal, the main plunger slide moves slowly at first and then increases its speed in finishing the stroke. All clutches are electrically controlled. A pump forces high-pressure grease to 160 lubricating points, and electric clutches provide for the safety of the operators or machine men. These are said to be the largest toggle presses ever built.

American Marine Notes.

The official report on the burning of the "Morro Castle" states that the disaster was due largely to failure of the human element. The captain should have sounded the alarm sooner, and should have turned the ship so that the fire would not sweep the decks. But when it was sounded there was no concerted action of the stewards in arousing and warning the passengers, and the crew did not take fire stations. The engine-room and fire-room watch stayed at their posts until compelled to use the emergency exits, but the chief engineer and first assistant neglected their duties. The Board recommended: (1) Higher standards of examinations for the licensing of ships' officers; (2) A.B.'s certificated only after three years' sea service and an oral examination; (3) more specific regulations as to fire drill and boat drill; (4) reorganisation of Government steamship inspection service, with technical staff to pass upon design; (5) immediate attention to fireproof construction and furnishings; (6) mandatory installations of thermostats or sentinels; (7) revision of laws relating to liability and salvage.—The motor river steamer "Peace" is designed for a speed of 12 miles an hour, or 8 miles when pushing a fleet of empty coal barges. It is designed for the 1952-mile run between Pittsburgh and New Orleans and has twin screws, with partial tunnels and a hull shaped to give a free flow of water to the screws. Length, 160ft.; beam, 30ft.; draught, 5½ft.; gross tonnage, 635; net tonnage, 560; bronze propellers, 5½ft. diameter and 4ft. 8in. pitch, each shaft driven by a six-cylinder Diesel engine of the direct reversible type, with cylinders 14in. by 18in., and of 375 h.p. at 250 revolutions. For effective manœuvring, there are six rudders, two aft and four forward of the screws, the latter arranged on either side of the shaft. An unusual feature is that the shafts are extended through the screws to bearings in outboard struts, fitted with roller bearings, thus eliminating overhanging weights and steadying the long exposed portions of the shafts.

Employment for Civil Engineers.

Although relief employment systems usually class engineers in general as among the so-called "white collar" groups, it has been pointed out they are largely outdoor workers. Most of the American relief expenditures have gone to the "working classes," and only about 4 per cent. to the white-collar unemployed. It is pointed out that there is an enormous field of employment for engineers in carrying on the mapping of the United States, which as yet has not even a completed skeleton, while many areas require filling in to give information essential for development. Besides this comprehensive triangulation and topographic survey work, there is a great amount of local work that might well be undertaken to the advantage of cities and communities. For example, surveys of street systems and city boundaries, land and tax maps, sewerage systems, underground utilities, such as water mains and electric conduits, surveys and investigations for city zoning and parking conditions. Unfortunately, professional and white-collar groups have never organised for protection, so that they are largely overlooked, partly because the needs of the working classes are more obvious, more loudly announced, and more generally recognised, and partly because the possible lines of employment for engineers and white-collar men are not realised by those in the relief administrative offices. Surveys and investigations—traffic studies, for instance—would employ not only the outdoor men, but also, in the aggregate, an army of draughtsmen, computers, and technical or semi-technical clerical help. A problem now before American engineers and engineering societies is to put forward and back up projects for the relief employment of this largely overlooked group of the unemployed.

Electrical Developments in America.

One of the striking features of the electrical industry in the United States is the extensive use of electric appliances in the household. This is a field which is being cultivated and extended by the manufacturers and power companies with quite astonishing results. From refrigerators, washing machines, and cooking ranges to curling irons and bed-heating pads, the list is almost endless. Records of a hundred power companies showed that in 1934 there were sold 111,492 refrigerators, 40,977 cooking ranges, 14,564 water heaters, 54,453 clothes washers, 11,713 ironing machines, and 616,203 of the innumerable smaller appliances. The total number was about 37,560,000 appliances, and their total value was about £5,500,000. These 100 companies serve about 10,500,000 domestic consumers of current, or about half the total number of such consumers. As compared with 1933, the increase in number of appliances sold ranged from 20 per cent. in washing machines to 152 per cent. for water heaters, while for the smaller appliances it was 34 per cent. This last group includes vacuum cleaners, sewing machine motors, flat irons, heating pads, and a variety of cooking devices for the table, such as coffee pots, toasters, waffle irons, &c. To develop this field the companies organise special campaigns of advertising, exhibits in local shops, and house-to-house visits. The invasion of the power supply field by the Federal Government is looked upon with serious anxiety by the power companies, as giving rise to serious—or even cut-throat—competition, due to the attitude of the Government officials. It is unfortunate that in invading this field the Government has seen fit to attack the electric power industry as backward and needing competition to make it give proper service to the public. In this respect it takes the same attitude that it has taken against the railways.

The Problem of Noise.*

By SIR HENRY RICHARDS, C.B., LL.D., Chairman of the Executive Committee, Anti-Noise League.

THE problem of noise as affecting individuals or societies is no new one. From the time when there existed any form of a stable urban civilisation, harassed citizens have complained of the din and rattle of city life just as they protested against bad housing or foul smells or dirty streets—especially in times of epidemic or plague.

Our present anxieties connected with the haphazard extension of London, our desire for a well-conceived scheme of town planning, the idea of a green belt, were all anticipated in Elizabethan and Stuart times. The history of the sixteenth and seventeenth centuries is full of regulations aimed against the indiscriminate spread of city life, and Sir Christopher Wren is the greatest and wisest of all town planners. There is evidence that definite steps to abate noise were taken by the Greeks several centuries before the Christian era.

"Professor Spooner"—I am quoting from the report of the New York Noise Abatement Commission—"in an article published in the *Guildhouse Monthly*, November, 1929, called attention to the fact that the city of Sybaris, founded in 720 B.C. in Southern Italy, became great and wealthy perhaps in part because of the regulations enforced by the authorities prohibiting industrial noises in residential areas and providing for zoning the city." Certainly philosophers from Seneca to Herbert Spenser have denounced noise as the enemy of thought and as the grave of culture. It was the latter who insisted that you could gauge a man's intellectual capacity by his intolerance of unnecessary noises. There are no lack of contemporary complaints of the "Roaring Forum" or of the clatter of the mediæval town. Indeed, at given times, in the forum or the mediæval market-place or the Oriental bazaar, the intensity of sound was not exceeded by that of our own modern towns.

The seriousness of present-day conditions arises not from any unparalleled intensity of noise, but from the fact that it is continuous and pervading in a degree never experienced before. The Industrial Revolution in this country substituted for agriculture and home manufactures vast factories and workshops furnished with machinery, which, in their turn, had to be served by an enormous increase of traffic. Then followed an unprecedented extension of urban existence, not in this country only, but more gradually and at a later stage in almost every country in the world, whether in the Occident or the Orient.

In quite recent years the internal combustion engine and the radio have brought with them not only an added quantity of sound but a different quality. To the rhythmical hum of a factory there is always possible a chance of adaptation, but the starting of a motor engine, the change of gears, the hoot of the horn are not rhythmical. They startle and alarm. Nor does the modern house protect us from either inside or outside noise like the very solid homes of our fathers.

As my colleague on the Anti-Noise League Council, Mr. Hope Bagenal, points out, it is roughly true that our buildings defend us from noise in proportion to their massiveness, and that thin modern drum-like floors, walls, and partitions tend to transmit sound. The safety of the public in all new housing schemes is carefully guarded as to strength of structure, but the natural sound insulation due to mass is sacrificed. As the din of modern town life increases, the power of avoidance decreases. No longer can we fly to the country for peace and tranquillity—ribbon development is scarring the whole land with lines of clamour. Not the most remote of villages is secure, and from the very heavens descends the roar of the aeroplane. The waters that once lapped the levels now threaten to overwhelm the heights.

If unnecessary noise is an evil, then, I think, we can all agree that the world is in a position of almost defenceless suffering. But is unnecessary noise an evil? It is quite evident that large numbers of people, especially young people, enjoy noise. There are thousands who apparently cannot appreciate the simplest meal without the accompaniment of a band. As an appetiser a saxophone is even more desirable than a cocktail. There are other thousands who find the sea or the river or the mountain top unendurable without a gramophone, and who demand a wireless set to mitigate the solitude and quiet of the motor car. To these bright spirits complaints about noise are seemingly meaningless or merely humorous—like jesting Pilates they ask, "What is noise?" And certainly wait for no answer. But it is a question that we must take more seriously. What, indeed, is "Noise"? Let us be frank. Any exact, scientific, or satisfying definition is not possible. In this, as in other matters, one man's food is another man's poison.

It was Spurgeon who, being asked the difference between Noise and Music, replied: "'Music' is the sound which our own children make as they romp through the house. 'Noise' is the sound which other people's children make under the same circumstances." I fear we can get no further than saying that "Noise" is unwanted sound, and it is unwanted when it is too loud or too shrill or too sporadic and uncertain. In other words, it is a question of volume of sound, pitch of sound, and ambiguity of sound, *i.e.*, when it is uncertain or unexpected, and lacks the soothing effect of rhythm. The dictionary will probably tell you it is a clamour, a din, an outcry which causes disgust and annoyance, and perhaps we can leave it at that. Most of us, who are neither physicists nor psychologists nor technicians, but quite ordinary people, know quite well what we mean by noise, though it is quite possible we become conscious of it gradually or in times of illness or mental fatigue. With most of us a half-conscious malaise develops into recognition of the source of the trouble, and a realisation that large numbers of fellow-sufferers have passed through a similar experience and are facing the same problem.

On the whole question of the bearing of noise on personal health, it is not for a layman to deal. Its actual effect on the auditory organs and its connection with deafness and partial deafness concerns only a relative minority of the population and is outside the limits of this paper. We have to recognise that noise of a very intense kind is necessary in some factories or workshops or shipyards. But even here we plead for some mitigation of the deafness and other physical and nervous suffering caused by riveting and the road drill. We know much can be done in this direction, to the great gain of the health and efficiency of the workman concerned. We are now primarily concerned with the much more general effect of ordinary every-day noise on the nerves and physical reserves of normal and healthy people. On this point the Anti-Noise League has ample evidence of the widespread distress experienced among large numbers of citizens, who are neither neurotic nor senile. In this connection, I feel that it is a little unkind of a recent investigator to suggest that sensitiveness to sound is a sign of neurosis. It is not a crime to be sensitive to foul smells or ugliness of any kind, nor do I esteem my sensibility excessive if I shrink from the torture of the Klaxon any more than when I feel repelled by a foul smell or the sight, let us say, of an empty salmon tin on a mountain height.

It is not for me to enter into the important question of noise and health. On this point the weight of medical testimony is overwhelming in its insistence that noise has a direct bearing on health. It is a testimony in accordance with common sense and personal experience. But there are certain sections of the community on whom the pressure of loud sounds or piercing sounds or startling and sudden sounds is obvious to the most inexpert mind. It is a very common experience that the healthiest of men awakes to the pain of noise when tired or indisposed. Then it is he gains some idea of the torture endured by the very sick and ailing to whom sleep and rest are essential. Whether of necessity or by mischance I do not known, but hospitals and nursing homes seem too frequently to find themselves in the most crowded and noisy parts of a town. It scarcely needs a medical man to point out that in these circumstances noise is one of the most serious contributions to post-operation collapse or retarded and incomplete recovery. In our factories and workshops and offices investigation has already taken place into the alarming results of noise—much of it unnecessary—on the nerves and temper of workers and the efficiency of their work. Noise means industrial fatigue, and fatigue means inefficiency.

The influence on education is no less striking. Recently the University of Oxford has been good enough to make a generous contribution to the expenses of the Anti-Noise League. I interpret that gift as a sign that the teachers of that ancient seat of learning are well aware of the need of some check on the growing plague of noise, even amid their peculiarly favoured surroundings. Reading the reminiscences of Dr. Farnell, the late Rector of Exeter College, I noticed that in the early part of his career he attributed the too prevalent intellectual slackness around him to the Oxford climate, but in his later years he refers more than ever to another cause, "the volcanic din," as he calls it, of the Oxford streets. On this particular topic I can talk with the knowledge of nearly forty years of educational administration, and I can say quite sincerely that the noisy situation of our town schools results in a lamentable waste of teaching power. With open windows in hundreds of class rooms instruction is impossible. The windows are closed, the air becomes foul, and lassitude is added to nerve strain.

It would be interesting to know to what degree the frequent nervous breakdowns that now afflict the teaching profession are due to the roar of traffic or the din of industry. In any case, the loss of teaching and learning power must be enormous. Noise is an expensive luxury, and it discounts the benefits of the most efficient staff and the most elaborate equipment. Were it possible to create round schools zones of silence the effectiveness of school work would, indeed, be increased—especially is this imperative in the case of very young children, so urgently in need of rest and sleep. I commend this question of noise to the consideration of the Board of Education and the Local Education Authorities.

I have endeavoured to sketch some of the results of noise on individuals and on specific sections of the community who are peculiarly open to its attack. I do not, however, think it fanciful to connect its presence in our midst with the wider issues of national and international phenomena. Is there no connection between the material and the mental and moral unquiet which shakes the whole world—that universal restlessness which seems literally afraid of quietude and reflection? Sound and movement do appear to play an extraordinary important part in political developments, and great European convulsions are accompanied by ceaseless bands, processions and dramatic salutations. Whether noise is the cause or effect of this world-wide abandonment of the tranquillities and harmonies of life it is hard to say, but of this I feel convinced: a campaign for peace and quiet in our streets and roads is not without its political and social significance.

The possibilities of noise abatement have excited attention in many countries besides our own. I have already quoted from the Report of the Noise Abatement Commission of New York, published in the autumn of 1930. "It is the result of serious study and work in medicine, neurology, otology, law, law administration, acoustics, engineering, construction, and the automotive industries. For the first time men skilled in the many fields that touch upon the noise problem have worked together in an effort to understand it in its wide-reaching ramifications, and to find ways of diminishing the clamour of our city." That is a just claim and it comes from realists who are concerned not only with comfort, or health, or the amenities of life, but with industrial output and commercial efficiency. In Italy, in great cities like Rome and Milan, drastic steps are being taken to restrain the noise of traffic, especially the motor horn. It is indeed interesting that Signor Mussolini—scarcely a neurotic or an invalid—has created round the seat of Government in Rome a silence zone lasting over the whole twenty-four hours. In Paris the motor horn no longer is heard, and Finland has eliminated it altogether. The interest in Germany is growing, though action is confined to the mitigation of noises causing deafness.

We in this country have been slow to act. The sacred tradition of *laissez faire* and *laissez aller* has permitted an indiscriminate urban growth—the undisturbed capture of arterial ways by ribbon development, a terrible toll of death on the roads, the hideous invasion of our countryside and, last but not least, this rising din which desolates and deafens country and town alike. Under the leadership of Lord Horder, the Anti-Noise League, from its headquarters, 66, Victoria-street, is doing its utmost to arouse public opinion on the scandal and danger of unchecked and unnecessary noise. It has approached, not unsuccessfully, Government Departments and the leaders of the motor and radio industry. I think I may say that the suppression of the motor horn in London during the night hours by the very courageous and enlightened Minister of Transport, Mr. Hore-Belisha, was not unconnected with the League's activities. But the real and permanent remedies cannot come from the mere action of a society, however vigorous. Let us realise that remedies do exist, and let us take courage from the history of the cobbled road, the iron tires, the dust-covered hedgerows of only yesterday, which have all in turn disappeared under the influence of science and invention.

The first great remedy is the power of science to cure the evils it has itself created. Science has given us the internal combustion engine, the radio, the electric road drill, the gramophone, the typewriter, the vacuum cleaner, and 1001 wonders which add to the efficiency and convenience of modern life, but also, alas, to its noise. It is quite certain that the volume and incidence of this noise can be enormously lessened. At the next meeting of this Society Commander Cave-Brown-Cave is going, among other things, to describe some of the attempts he has successfully made to modify the exhaust noises of motors, and I have neither the knowledge or desire to anticipate what he is going to say. Nevertheless, I may perhaps be permitted to touch on some of the experiments in noise abatement which will be demonstrated at The Noise Abatement Exhibition, organised under the auspices of the Anti-Noise League, to be held next June in the Science Museum, South Kensington, if only for the purpose of indicating some of the alleviations to which in the future we may look forward.

We hope to demonstrate all those constructional improvements which the study of acoustics is likely to give us. There will be an exhibit of the Silent House with soundproof ventilating windows, a soundproof door, a silent lift, and silent locks. There will be demonstrations of industrial noises made in two boxes, one soundproof and the other not.

In the exhibit connected with transport and machines we hope to show an efficiently silenced motor cycle, an extremely quiet motor, silent vacuum cleaners, a silenced road breaker, and exhaust silencers of all kinds. We hope also to give some idea of the intensive research now being organised into the question of noise measurement and noise analysis, and into the effect of noise generally on the hearing, the nerves, and health of industrial workers. These are the constructive remedies to which we all attach the utmost importance.

The other important remedy is suppressive rather than constructive—I mean legislation and the enforcement of the law. Here, again, I speak not as a lawyer but as a layman, quoting largely from a paper read at a meeting of the League, held last summer in Oxford. In theory, as I understand it, excessive noise is hardly ever beyond the reach of the law. In practice, it often is. In order to be within the reach of the law, noise must amount to a nuisance in the legal sense or offend against some statute. Nuisances are of two kinds, public and private. If public, it is a misdemeanour for which an indictment will lie at common law, but otherwise the only remedy is a civil action. We have, therefore, in one way or another, legal remedies which appear to cover all contingencies. And yet for a multitude of reasons these remedies are partially ineffective.

What are the factors which contribute to this ineffectiveness?

(1) The first is the cost of proceedings, a cost which may be worth incurring in the case of a nuisance that has come to stay, but not worth while in the case of a visiting nuisance, or rather a nuisance by a series of visitors who succeed one another in rapid succession; (2) the second factor is reluctance to prosecute; (3) the third unwillingness to give evidence; (4) the difficulty of catching offenders, especially at night. Finally, there is always a reluctance to enforce the law unless it is supported by public opinion. Sir Henry Maine long ago pointed out "for every man who keeps the law through conscious fear of punishment, there may be hundreds who do so as it were instinctively and without a thought on the subject." This law-abiding spirit owes its origin very largely to the enforcement of law over a long period of time. Accordingly, laws enacted but not enforced impair the law-abiding spirit.

We come therefore at long last to the only real remedy in this country, the force of public opinion. Let me summarise the points on which we seek to concentrate public attention. I have endeavoured to show that, as Mr. Priestley says, the world is getting "noisier and noisier." "If," he says, "we do not take care, all the more sensitive people in it will go mad." Noise has increased, is increasing, and ought to be diminished. We realise that much of this noise is unavoidable, but we also maintain that much of it is quite unnecessary. Coincident with this rising tide of noise is the fact that in neither town nor country is there any harbour of refuge. In the country remoteness is no longer a protection. In the towns our houses—light and airy as they may be—no longer mask the sounds, either of impact or vibration. Like ribbon development, this disease is getting out of hand. Noise, like other things, creates vested interests. Its harmfulness is scarcely in dispute. Unconsciousness of noise and apparent "adaptation" to noise is no protection from its effects. The effects of noise have been described as merely "emotional," but emotion is only the end product of the process. Long before the emotions are disturbed there are disturbances expressed in heightened pulse rates, increased blood pressure, irregularities in heart rhythm and increase of pressure in the brain itself. Even to the so-called insensitive temperament noise is harmful—to the sensitive it is torture, to the sick and ailing it may be fatal.

To particular sections of the community—to brain workers and to industrial workers noise becomes a social wrong. Noise is indeed a social and civic evil. It takes its place with bad sanitation, bad housing, rural pollution, as a crime against society. Moreover, there are remedies available—remedies which, as a matter of fact, are not unreasonably costly. In this campaign against unnecessary noise we are entitled to appeal to the highest feelings of a community. So much of the evil arises from lack of consideration and patience. In his notable speech to the

* Royal Society of Arts, Wednesday, March 6th.

Church Assembly the Bishop of Ely appealed to the conscience of the community in its attitude to the horrible figures of deaths on the road. He rightly maintained that a little more Christian charity might almost solve this terrible problem. The same consideration and charity would go a long way to solve the noise problem as well. It is a problem involving many considerations—medical, scientific, industrial, and legal—but perhaps after all the most likely approach to a solution is an ethical one.

High-Voltage Alternators.*

Some ten years ago it appeared as if the voltage of turbo-alternators had become fixed at about 11 kV, and the arrangement of an alternator with its step-up transformer raising its voltage to 33 kV was accepted as standard practice. Already, however, the turbo-alternator sets were being built in such sizes that the heavy currents, which had to be led away from the machine, were causing the designers serious embarrassment. Sir Charles Parsons and his colleagues foresaw that this trouble would only be aggravated with further increase of size of units in the future. So in 1921 research was commenced on the problem of direct generation at 33 kV.

These labours first bore fruit in 1928, when the first high-voltage machine was installed in the new power station at Brimsdown. About the same time the Americans had been forced, purely by design difficulties, to increase the generating voltage of certain of their big sets to 22 kV, the normal type of conductor being adhered to and only additional insulation added. The latter type of alternator has since been developed in this country for generation at 33 kV.

As the concentric conductor machine at Brimsdown has now been in service for more than six years, while several others of similar design, including another in the same station, have been in service for smaller periods in different parts of the world, their reliability would seem to be established.

The alternator is of standard construction, with the exception of the slot conductors and the arrangement of the end connections. The stator slots are circular, and are arranged in a number of rows depending on the output of the machine. There are three concentric conductors per slot, the middle one being circular, and they are built up of spiralled layers of insulated copper wires. For brevity, the conductors are referred to as the "Bull," "Inner," and "Outer" respectively. The centre conductor is wrapped with an insulating tube of flexible mica to a predetermined thickness, and the second, or "inner" conductor, which consists of a single layer of wires, is wound in spiral formation round this insulating tube. The next layer of mica, followed by the "outer" conductor, and the last wrapping of mica, are applied in a similar manner. The spiral winding of the wire reduces trouble due to eddy currents, while the conductor is impregnated after each application of mica insulation. The conductors are connected so as to form a concentric winding, the outer conductors being in series with one another, followed by the inners, and finally the bull conductors. Thus the centre conductors operate at the maximum potential, and in every slot the inner conductor is two-thirds and the outer one-third of the potential of the centre conductor.

After completion each conductor is dried in an oven for a certain period, and then subjected to a pressure of 100 kV on the bull, two-thirds of that voltage on the inner, and one-third on the outer simultaneously. During the application of these voltages, the dielectric losses are measured by means of a Schering bridge, and any bar which shows a figure above a certain limit is subjected to further drying and retested. Having passed this test, each bar is subjected to a voltage of 30 kV, the bull, inner, and outer conductors being coupled together for the purpose. Special non-magnetic end shields are provided which can be attached to the studs holding the end windings, a practice inadmissible with cast iron shields.

In the normal type of high-voltage alternator the most important feature is the insulation of the conductors. The mica folium used for this purpose is prepared by pasting several thicknesses of mica in the form of splittings to overlay upon a sheet of strong tissue paper. The bond used is bitumen, which is chemically inert, and the thickness of the finished sheet is 5/1000in. These sheets are cut up into strips and applied to the conductor bars with a certain amount of overlay.

The advantages of a higher generated e.m.f. are:—(1) The saving effected by elimination of the transformer for the local h.t. transmission at 33 kV. Also the saving due to the absence of transformer losses, the amount of which, when capitalised, forms a considerable part of the total capital outlay. (2) The reduction in the cost of the cables connecting the alternator to the bus-bars. In addition, the problem of bringing the current away from the alternator is simplified owing to the reduction in the quantity of this current. In a comparison of the installation costs of an alternator generating at (*a*) 11 kV and at (*b*) 36 kV, the cost of the cables in (*a*) came to £39 per yard run, and in (*b*) to £21 per yard run; these figures being for the total number of cables required, *i.e.*, eight in the first case and thirty-six in the second. (3) A lower full-load loss as a result of eddy currents due to the reduction in the quantity of current in the windings. This reduction in the quantity of the current also reduces the stresses on the windings when the machine is subjected to short circuit.

The advantages applying only to the concentric-conductor machine are:—(1) A more efficient utilisation of the insulation by the intersheathing effect of the concentric conductor. This type of conductor has some features of resemblance with the intersheath-graded cable; one difference is that the intersheath carries none of the useful load. (2) The resistance to voltage surges. A factor which reduces the severity of the voltage surges in the winding is the inherently high capacitance between the turns, thus these capacitances form a capacitance chain to earth which presents a relatively lower impedance to a surge as compared with the normal type of conductor. (3) In order to reduce the current on short circuit to the same percentage of the full-load current as in the low-voltage machine, it is necessary to give the high-voltage machine an inherent reactance equal to that of the low-voltage machine and its attendant transformer. The arrangement of the slots makes this a simple matter, also by this arrangement the flux density in the stator is kept uniform, and a uniform distribution of winding is obtained.

It is usual to operate these 33-kV alternators with an insulated neutral, although they can work with an earthed neutral point. Under working conditions the insulation to earth of the outer at the neutral point is only subjected to one-third of the phase voltage. If an earth fault occurs on one phase, the voltage of the neutral point will possibly rise to the phase voltage, in which case the outer of a 36-kV machine will be subjected to a maximum voltage of 26 kV. This figure is, however, well below the breakdown strength of 80 kV. The normal type of high-voltage machine will not suffer from this disadvantage to the same extent, but it does not possess the advantages mentioned above in connection with the concentric-conductor machine alone.

High-voltage alternators of the concentric-conductor type have a high internal reactance, while the short-circuit current is relatively low, and they are all subjected to repeated short-circuit tests across the terminals at full speed and voltage.

As it is impracticable to dissipate the full amount of energy generated during heat runs, the windings are rearranged so as to circulate current, *i.e.*, with the three sections of each phase in parallel. The difference in voltage between the bull section and the other two sections causes a circulating current which is controlled by a choke in the circuit. On completion of the winding the following pressure tests are applied between phases and the earth (all sections simultaneously):—Bull conductor, 67,000 volts for 1 min.; inner conductor, 45,000 volts for 1 min.; outer conductor, 23,000 volts for 1 min. The machine is thus subjected to the same stresses as if it were generating at 116,000 volts.

If it is necessary to raise the generating voltage from 11 kV to 22 kV on account of the difficulties with the heavy currents, as has happened in America, it would seem to be preferable to raise this voltage to 33 kV, instead of stopping at 22 kV, as then the transformer for local transmission is no longer necessary.

The existence of alternators which generate at 33 kV makes it possible to step up to 66 kV with auto-transformers. While this would be less economical than direct generation at the higher pressure, it would be cheaper than using a low-voltage generator and normal transformer.

* Abstract of a paper read by Mr. P. E. Crawshaw Smith before the Students' Section of the Institution of Electrical Engineers.

Conserving South African Rainfall.

Having determined that the protection of the catchment areas of the Union is a matter of national importance and should be commenced immediately, the Government has decided on a policy of far-reaching importance. It is its aim to extend a network of reservoirs and storage dams so that it will at last cover the Union or most of it. The ultimate goal is the control of the entire rainfall, a gigantic task which cannot be completed in one generation. Already the thing is taking shape. When the Vaal-Hartz and the Loskop dams are completed—in about four years' time—the rainfall over a vast area comprising practically the whole of the Transvaal high veld, and a very large area in the north-western Free State, embracing the districts of Heilbron, Frankfort, Harrismith, Vrede, and Bethlehem, will be impounded or controlled. There will be a network of sixteen dams, and the area served by them will stretch from the Drakensberg escarpment almost 300 miles across country to Zeerust, down from Zeerust to Schweizer Reneke, back towards the Drakensberg, through Witpoort, Klerksdorp and Johannesburg, and southwards to beyond Bethlehem—300 miles from east to west at its longest and about 200 miles from north to south at its broadest. For the rehabilitation of the farmers of the South-Western Free State, who have been badly hit by a succession of droughts, it is proposed to throw earthwork dams across the Modder and Riet Rivers, which, it is hoped, will have the desired effect. This scheme will make possible the impounding of the rainfall of a vast catchment area, including the districts of Bloemfontein, Winburg, Thaba Nchu, Edenburg, and portions of the Smithfield and Phillipolis districts. In addition, however, the scheme will benefit a huge area below the catchment area, including all the districts through which these rivers pass. It should, in fact, benefit the country right down to where the Reit River joins into the Vaal. The earth dams it is proposed to throw across the rivers will offer the maximum amount of employment at the very low estimated cost of £500,000. This project is the second instalment of the Government's ambitious scheme for controlling the rainfall which falls on South Africa.

The Irrigation Department of the Union has done much important work, since the Union of South Africa came into existence, in impounding the waters of the country, and within a few years practically all the water that falls in normal years along both faces of the Witwatersrand and extending along the western face of the Drakensberg escarpment, to the Basutoland border, will be caught up in dams and prevented from running uselessly, even destructively, to the sea. Beginning in the west some of the big schemes are the Schweizer, Reneke, Witpoort, Klerkodorp, Groot Marico, Commisse Drift, Boschpoort, Hartebeespoort, Bon Accord, Potchefstroom, Klipdrift, Rust der Winter, and later the construction of dams at Klein Marico, Buffelspoort, Loskop, and Vaalbouk. These, of course, are apart from the other schemes in other parts of South Africa. The total drainage area of this scheme is roughly 31,000 square miles, and a very large proportion of the water which would run to waste will be held and turned to useful purposes. The total storage capacity is about 1¼ million acre-feet, *i.e.*, as much water as will cover a million acres 15in. deep will be caught each year.

For a start the Government will concentrate on the Modder River-Riet River schemes. The report of Mr. D. Lewis (Director of Irrigation), which was only recently received by Government, is so favourable that an immediate start is to be made with investigation work, and the Minister is going to ask Parliament to approve of the expenditure of a preliminary sum of about £200,000 on this and an extension of the scheme to a portion of the Caledon River. The Director recommends that an immediate detailed engineering investigation of the Riet River and the Modder River catchment areas, and of the Kalkfontein site on the Riet River should be undertaken. He also recommends that an engineering and geological reconnaissance should be made of every tributary within the catchment area of these two rivers to discover all possible sites for moderate-sized schemes, and that the best arrangement of these should be determined. It is expected that there will be six dams on the Riet River and five on the Modder. One large undertaking carried out last year was the Groot Marico-Bosveld scheme. The dam there is an earthen dam nearly a mile long, and with a maximum height of 100ft. The storage capacity is 24,000 acre-feet, which is the equivalent of 6,500,000,000 gallons. The dam was completed last year just before the rains, and was filled to overflowing before the end of the rainy season. The area that will be irrigated will be 2500 morgen, or over 5000 acres, of which Government has acquired about 40 per cent. with a view to placing settlers thereon. The cost of the whole scheme was £270,000, which is very close to the estimate.

LAUNCHES AND TRIAL TRIPS.

Rita, twin-screw steam tank ship; built by the Netherland Shipbuilding Company, Ltd., to the order of the Curaçao Navigation Company (Royal Shell Group); dimensions, 335ft. by 56ft. by 22ft. 6¼in.; to carry oil in bulk. Steam engines of 2500 i.h.p.; constructed by Werkspoor N.V.; launch, February 23rd.

Anadara, Single-screw motor tanker; built by Harland and Wolff, Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, 460ft. by 59ft. by 34ft.; to carry oil in bulk. Diesel engines, Harland-B. and W. type; constructed by the builders; trial trip, recently.

Saganaga, steel screw steamer; built by D. and W. Henderson and Co., Ltd., to the order of Messrs. Chr. Salvesen and Co., Leith; to carry cargo. Engines, triple-expansion; constructed by the builders; launch, March 6th.

Duke of York, twin-screw steamer; built by Harland and Wolff, Ltd.; to the order of the London, Midland and Scottish Railway Company; dimensions, 349 ft. by 52ft. by 19ft. 6in.; to carry passengers and cargo. Engines, turbines of Parsons type. Launch, March 7th.

New Zealand Star, motor vessel; built by Harland and Wolff, Ltd.; to the order of Blue Star Line, Ltd.; dimensions, 516ft. 9in. by 70ft. by 43ft. 4¼in.; to carry cargo and passengers. Diesel engines of Harland-B. & W. type; constructed by the builders. Trial trip, recently.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

A. C. Wickman, Ltd., Coventry, has been appointed sole agent in the British Isles for the thread milling machines made by Geo. Moulton, Ltd., Manchester.

Steele and Cowlishaw, Stoke-on-Trent, have now opened a London office, and have appointed Mr. W. Royston Laidlaw as their representative. The address is 329, High Holborn, W.C.1. Telephone number, Holborn 1695.

Peter Stubbs, Ltd., Warrington, have appointed Mr. H. Sharp, of Sandfield-road, Arnold, Nottingham, as their representative for the counties of Lincolnshire, Nottinghamshire, Derbyshire, and Leicestershire, and for the city of Peterborough.

Anderson and Co., engineers and agents, have taken over the sale in India, Burma, and Ceylon of the whole of the products of J. Browett-Lindley (1931), Ltd., and Kryn and Lahy (1928), Ltd., of Letchworth, Herts. Anderson and Co., whose head office is at Ballard Estate, Bombay, have branches throughout India, Burma, and Ceylon.

The Central Electricity Board has appointed Mr. J. W. Beauchamp, who for the past five years has been the Board's District Manager for the South-West England and South Wales area, to be the Board's Commercial Manager. The Board has also appointed Mr. J. T. H. Legge, who until recently was managing director of the Shropshire, Worcestershire, and Staffordshire Electric Power Company, the South Wales Electric Power Company, and Edmundson's Electricity Corporation, Ltd., to succeed Mr. Beauchamp as the Board's District Manager for South-West England and South Wales.

The Late Mr. C. W. Bryant.—We regret to announce the death, at the age of sixty-eight, on March 2nd, after a long illness, of Mr. C. W. Bryant, C.B.E., managing director of Peter Brotherhood, Ltd. Mr. Bryant joined the firm as general manager in 1902, and became managing director on its becoming a private liability company in 1907. He was awarded the honour of Commander of the Order of the British Empire in 1917 for his services to the nation during the war.

Metal Industries Exhibition in Japan.—An International Metal Industries Exhibition and Congress will be held in Boekikan, the Commercial Museum in Osaka, Japan, between May 10th and 31st, 1935. The Exhibition has been arranged by AGNE (publisher of the *Journal of Metals*, Okamoto, near Kobe), and the Nikkan Kogyo Shinbun-sha (*The Daily Industrial News*). The following items can be shown at the Exhibition:—Castings, rollings, forgings, extrudings, heat treating, platings, weldings, workings, raw materials, minings, refinings, machines and tools for metal industries, &c. Entries must be delivered by May 31st, 1935. The rent of stands is 25 to 30 yen.

Short Courses for Engineering Teachers, 1935.—The Board of Education are making arrangements for short courses for engineering teachers in technical colleges and schools, to be held at New College, Oxford, from Saturday, July 20th, to Wednesday, July 31st, 1935. There are two courses in engineering science, consisting of lectures and discussions to be conducted by Dr. W. Abbott, Dr. W. E. Fisher, Professor B. P. Haigh, Professor F. C. Lea, Mr. A. W. Loveridge, Dr. T. J. Murray, and Mr. F. H. Reid. An electrical engineering course, devoted mainly to the subject of radio communication, will be conducted by Professor G. W. O. Howe, Mr. E. B. Moullin, and Dr. E. Mallett, together with other lecturers drawn from the radio industry. A series of evening lectures on various subjects of interest to all members of the courses will be given by Mr. A. S. Barnes, Dr. H. Gough, F.R.S., Professor B. P. Haigh, D.Sc., Professor C. E. Inglis, F.R.S., and Dr. F. H. Spencer. Applications from suitably qualified teachers should be sent to the Board of Education on Form 106 U (T) not later than March 30th, 1935. Full particulars of these courses may be obtained from the Secretary, Board of Education, Whitehall, London, S.W.1.

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

International Steel Trade Talks.

Meetings of great importance to the iron and steel industries of the whole world were held last week on the Continent. The Executive of the European Steel Cartel met at Cannes, and a meeting of the International Rail Manufacturers' Association (I.R.M.A.) followed. Subsequently, the British steel makers and representatives of the European Steel Cartel met and discussed the question of a Continental steel quota for the British market. At the beginning of this week also the International Tube Cartel held a meeting at Brussels. The results of these discussions have not yet been officially announced, but, with the exception of the tube meeting, they would seem to have been satisfactory. It is stated that agreement has been reached by the French and German industries with regard to the disposal of the Saar production, and, more important still to this country, substantial progress appears to have been made at the meeting of the British and Continental steel makers. According to reports, the discussion resulted in the recognition that a quota for the British market must form part of a plan to include the export markets. Those present at the meeting were not empowered to enter into definite agreements, but it is understood that negotiations reached a stage which warranted the fixing of another meeting to take place in the middle of April. Both sides appear to think that the question of the quota is in a fair way to being settled. Support is lent to this view by the announcement that it had been decided to prolong the I.R.M.A. agreement, which would otherwise have expired at the end of March, until June 30th, as it had been stated that in the event of a failure of the negotiations regarding the quota for Great Britain, the Continent would withdraw from the railmakers' organisation. The meeting of the International Tube Cartel, which was held at Brussels, does not seem to have been attended with the same success. It appears almost certain that the Continental Tube Cartel will be dissolved. Already the Czechoslovakian Tube Association has broken up, and whilst the German and French organisations may remain in operation, it is stated that the International body will be dissolved. Prices have already been reduced by some of the Continental tube works.

The Pig Iron Market.

Taking the pig iron market as a whole, conditions are satisfactory, but some irregularity in demand has developed in some departments and in one or two districts. For instance, whilst a few of the steel works on the North-East Coast are rather short of supplies of basic iron, the call for foundry iron has been disappointing for the past two weeks. There have been inquiries in the market which it was believed indicated that the usual spring expansion would shortly make itself felt; but these have not been followed up, and for the time being the foundry trades' requirements of Cleveland iron are less than normal. Disappointment is expressed that the shipments of iron to Scottish founders fail to increase in accordance with expectations. On the other hand, deliveries to users on the North-East Coast have been distinctly good, and, in addition, there has been some fresh buying by the local foundries. The producers maintain that they have no unsold stocks worth speaking of, and that they have heavy contracts on their books. Nevertheless, it is probable that there have been small additions to stocks of foundry iron, which, however, should be worked off as soon as the demand improves. Export business this month has been quiet so far, but the makers are disinclined to cut prices to the extent often necessary to secure business in competition with the Continent. In the Midlands, whilst the situation of the producers as regards order books and stocks is not perhaps so good as on the North-East Coast, the requirements of the market appear to be slowly increasing. This is the more satisfactory as many of the important consumers have covered their prospective needs as far forward as the end of June. Buying is thus almost entirely restricted to the smaller concerns and gives to current business a hand-to-mouth appearance. In the aggregate, however, these orders amount to a respectable tonnage. In Lancashire business in foundry qualities is steady, but without any particular feature. The Scottish market has been moderately active, and it is claimed that the whole production of the six furnaces in Scotland engaged on foundry iron is passing into consumption. The steel works' requirements of hematite are large, but as most of them have bought for a considerable period ahead, little interest is being shown in forward buying. Business in basic iron is on a heavy scale. Many of the steel works, however, take their supplies from associated plants, so that comparatively little of this business comes on the open market. It is expected that the production of basic will be increased in the near future.

Scotland and the North.

Busy conditions rule in the Scottish steel trade; the works are operating nearly at capacity and so far as can be seen will continue to do so for a long time to come. The production of shipbuilding steel is on a heavy scale, and whilst some contracts have been worked off it is anticipated that fresh orders from the shipyards will make up for those which have been completed. Inquiries for several new vessels are now in circulation, and it is hoped that the Clyde will shortly secure contracts for new tonnage which will include cruisers for a foreign Government. The steel market is therefore able to regard the future with optimism, although in one or two of the lighter branches of the industry business is not so good as earlier in the year. The structural engineers in Scotland are well occupied and some important bridge building work is in hand, which creates a good demand for structural steel material. The sheet industry is one of the least active branches of the market. There is a fair demand for black sheets from home consumers, but business on export account is restricted to small parcels. The re-rollers are finding that trading conditions improve as the season progresses, and they have also benefited by the diversion of orders from the Continent to British works resulting from the application for higher duties. The Lancashire steel market has been rather colourless during the past week. A number of users covered their requirements recently in anticipation of an increase in the prices of structural steel which did not eventuate, and are now showing little interest in the market. There has been no substantial increase in the demand for plates, although it is slightly better than in the latter part of February. On the lighter side of the industry the volume of business shows no signs of contracting. The request for bright steel bars lately has been a good feature of the market. Since the application for higher duties practically nothing has been heard of transactions in Continental steel.

The Midlands and South Wales.

Conditions in the Midland steel market are not quite so active as is often the case at this time of the year. For some reason there has been a halt in the development of the usual spring demand, which is considered by a good many to be due to political influences, and to be of a temporary character. A feature of the trade position in the Midlands is that whilst the structural engineers have some very useful orders in hand, for the past fortnight or so they have placed comparatively little business with the steel works. No doubt in many cases they bought forward on a good scale just prior to the steel makers' quarterly meeting, with the intention of securing supplies in case a price advance was made, but this scarcely accounts for the rather hand-to-mouth buying which has taken place since. On the other hand, business with the Continent has been so limited that it seems hardly possible that the imports of foreign steel have been sufficient seriously to affect the purchase of British material. Business in plates has been slightly better this week, but the demand cannot be considered satisfactory. The sheet market also has shown no improvement, and consumers for the most part have been content to cover their needs by the purchase of small lots as they required the material. One of the brighter features of the Midland steel trade has been the revival of business in small bars. This is taken as a sign that the spring demand is beginning, since many of the orders have come from foreign markets which normally buy at this time of the year. There is still keen competition in the market between the associated and unassociated British works, and the importers of Continental steel. The latter, however, have not been so troublesome lately, owing to the uncertainty felt regarding the application for an increase in the import duties. The collieries have been taking fair supplies of steel, but most of this has been against contracts and new business has been rather scarce. The iron and steel market in South Wales has been quiet. A moderate home demand is being experienced, but export trade has been poor. The tin-plate industry has not improved its position, and is apparently waiting for the other foreign industries which are parties to the international agreement to fill their quotas before actively competing for export business.

Current Business.

Dorman, Long and Co., Ltd., have obtained a contract for the construction of an engine and boiler-house at the Hardingstone power station. The work will involve the use of about 1300 tons of steel. The Durham County Council has awarded a contract to Sir Robert McAlpine and Sons, Ltd., for a bridge at Belasis-lane level crossing, Billingham-on-Tees. The London and North-Eastern Railway Company has ordered 250 12-ton wagons from Cravens Railway Carriage and Wagon Company, Ltd., of Sheffield. David Brown and Sons (Huddersfield), Ltd., gear makers, have bought premises and 27 acres at Penistone, formerly occupied by the steel works of Cammell Laird and Co., Ltd. It is intended to use the property for the manufacture of heavy castings and other engineering products. The North British Locomotive Company, Ltd., of Glasgow, has taken an order for twenty locomotives for Egypt. The order may be increased to fifty. The engines for two new oil tankers ordered recently by the Anglo-Saxon Oil Company from Swan, Hunter and Wigham Richardson, Ltd., of Wallsend-on-Tyne, are to be supplied by R. and W. Hawthorn, Leslie and Co., Ltd. The Department of Overseas Trade reports that the following contracts are open for tender:—Brazil, Viacao Ferrea do Rio Grande do Sul: 136 axles (rough) for engines, carriages, and wagons (Brazil, March 28th). Lahore, North-Western Railway: Steel castings (axle-box bodies, horn blocks, drag boxes, and piston heads), (Lahore, April 17th). Indian Stores Department: 80 platform wagons, 2ft. 6in. gauge, and 100 crane skips (New Delhi, April 3rd). Persia, Ministry of Ways and Communications: 2300 running metres of galvanised corrugated sheet culverts, approximate diameter 1000 mm. (Tehran, March 31st). South African Railways and Harbours: About 163 tons of steelwork for strengthening and widening railway bridges (Johannesburg, April 1st). Siam, Royal State Railways: Cold-drawn steel locomotive boiler tubes and pressed steel doors (Bangkok, April 5th). New Zealand, Christchurch Tramway Board: Trolley omnibus chassis and, alternatively, compression-ignition omnibus chassis (New Zealand, April 22nd). Egypt, Ministry of Public Works: Steel windows at Fouad-el-Awal Hospital (Cairo, April 8th); Ministry of Communications: Aeroplane hangar at Dekheila Airport (Egypt, April 8th). H.M. Trade Commissioner at Sydney reports that a local firm wishes to be placed in touch with United Kingdom manufacturers of aluminium tubes with caps 4in. by ⅝in., and 2½in. by ⅝in.

The Copper Market.

Interest in the electrolytic copper market this week has centred upon the meetings between the European, African, and American copper producers in New York. So far, no definite news has been received as to the progress of the negotiations, but it is understood that the European producers are attending the Conference with a cut-and-dried scheme, the details of which had been furnished to the American producers beforehand. The proposals include the limitation of production all round by 25 per cent. and the curtailment of exports of American copper. The negotiations will take time, and probably will be of a rather delicate character, since few companies can face the prospect of cutting down their outputs with equanimity, many of them having spent large sums upon the development of plant during the past year or two for the sole purpose of increasing their production. The market, however, is more hopeful now than at any time that an agreement will be reached, and it is pointed out that any failure to do so would result in a fall in the price of copper, whilst if an arrangement were arrived at, values would be likely to advance several pounds. The formation of a pool to hold the copper produced by the nickel companies has undoubtedly helped to bring the varied interests together. The demand from consumers has not been greatly influenced by the negotiations, in spite of the possibility of higher prices ruling shortly. Buying has been of a hand-to-mouth character, and little inclination has been shown to purchase forward. There has been an increase in speculation in the London standard market lately, and a good demand has ruled for options. Much of the copper purchased by speculators seems to have passed into strong hands, and in some cases it has been taken off the market. Considerable stocks of copper exist, however, and last week the total stocks in London Metal Exchange official warehouses increased by 2813 tons, the figures on March 9 being 11,480 tons of rough copper and 55,287 tons of refined, making a total of 66,767 tons. In America the copper position seems to have been upset by the break in the cotton market which has exercised an unfavourable influence over business of all descriptions. As a result there has been a tendency for the price of copper to become easier, in spite of the optimistic view which is taken in that country regarding the copper producers' discussions.

The Tin Position.

Certain aspects of the tin position have been so much in the limelight during the past few days that it is hardly surprising that the speculative element has left the market very much alone. Stories which have appeared in print of a "bear raid" can be dismissed as imaginary, since the market has been so much under control in spite of the decline in prices that bear operators might have found themselves in considerable danger. The downward movement in prices seems to be almost entirely due to the absence of support from groups which are generally supposed to be associated with the control. There has been so much discussion of late regarding the price of the metal that a section of the market is inclined to believe that the quotation will be pegged at a lower figure than has ruled for some months past, but, of course, this is pure surmise. Keen interest is felt in the meeting of the International Tin Committee, which will take place this week, and at which it is understood the question of quotas will be discussed. There is some expectation that these will be increased, but the market is by no means sanguine on this point. Whilst the position has been disturbed by outside attacks on the market and uncertainties within, business has been on a rather restricted scale, as few consumers have cared to commit themselves. American buying has been limited to a few odd parcels, and Continental buyers seem to have adopted a policy of waiting until the position has become clearer. In the meantime the backwardation in the market remains at about £4 10s., and it is this as much as anything which has created discontent, since it forces all dealers to be on the bull side for their own protection and acts as a check upon legitimate hedging business.

Lead and Spelter.

Nothing has occurred in the lead market to disturb the steady conditions which have ruled for weeks past. The demand from British consumers, which during the latter part of January showed a tendency to decline, is now beginning to pick up again as a result of the spring demand for manufactured lead products. The building trades, of course, provide an important outlet for lead materials and the demand from this quarter is just beginning to make itself felt in some volume. It is claimed, however, that the operation of the import duty, into which the Import Duties Advisory Committee is inquiring, will continue to act as a check upon any advance in prices. It is understood, however, that a new scheme has been put forward which would alter the incidence of the duties and it is suggested keep the price pegged at about £13. . . . Consistently weak conditions have ruled in the spelter market, largely, it would seem, as the result of the lack of interest shown by consumers of the metal. The decline in the demand has been the only noticeable change in the position, but it has been sufficient to keep prices at almost the lowest point touched this year. Declarations of Belgian spelter have resulted in a contango developing, but it seems doubtful if there will be much Polish spelter sent to this country for a time. In the American market the tone has become firmer, partly as a result of the improved demand from consumers there and also because a scheme for a 15 per cent. restriction of output at the American mines has been adopted. According to American statistics the world production of zinc during January totalled 120,636 tons compared with 119,548 tons in December. The revised figures of the world production in 1934 give the total as 1,285,328 tons.

Current Prices for Metals and Fuels.

Makers' official home trade prices, per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists, 22s. 6d.: plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home.	Export.
	(*D/d Teesside Area*)	
N.E. COAST—	£ s. d.	£ s. d.
Hematite Mixed Nos.	3 8 6	3 2 0
No. 1	3 9 0	3 2 6
Cleveland—	(*D/d Teesside Area*)	
No. 1	3 10 0	3 4 0
No. 3 G.M.B.	3 7 6	3 1 6
No. 4 Forge	3 6 6	3 0 6
Basic (*Less 5/– rebate*)	3 7 6	—
MIDLANDS—		
Staffs.—	(*Delivered to Black Country Station*)	
North Staffs. Foundry	3 11 0	—
„ „ Forge	3 6 6	—
Basic (*Less 5/– rebate*)	3 12 6	—
Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
SCOTLAND—		
Hematite, f.o.t. furnaces	3 11 0	—
No. 1 Foundry, ditto	3 12 6	—
No. 3 Foundry, ditto	3 10 0	—
Basic, d/d (*Less 5/– rebate*)	3 7 6	—
N.W. COAST—		
Hematite Mixed Nos.	3 12 6 d/d Glasgow	
	4 0 6 „ Sheffield	
	4 5 6 „ Birmingham	

MANUFACTURED IRON.

	Home.	Export.
LANCS.—	£ s. d.	£ s. d.
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. YORKS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
MIDLANDS—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	7 5 0 to 7 15 0	—
SCOTLAND—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. COAST—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

	Home.	Export.
LONDON AND THE SOUTH—	£ s. d.	£ s. d.
Angles	8 10 0	7 7 6
Tees	9 10 0	8 7 6
Joists	8 17 6	7 7 6
Channels	8 15 6	7 12 6
Rounds, 3in. and up	9 10 0	8 7 6
„ under 3in.	8 14 6	7 0 0
Flats, 5in. and under	8 14 6	7 0 0
Plates, ¾in. (basis)	9 0 0	7 15 0
„ ⅜in.	9 5 0	8 0 0
„ ½in.	9 10 0	8 5 0
„ ⅝in.	9 15 0	8 10 0
„ ¾in.	9 10 0	8 5 0
NORTH-EAST COAST—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Plates, ¾in.	8 15 0	7 15 0
„ ⅜in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ ⅝in.	9 10 0	8 10 0
„ ¾in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 5 0	8 5 0
MIDLANDS, AND LEEDS AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ ⅜in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ ⅝in.	9 12 6	8 10 0
„ ¾in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 7 6 .. 7 15 0	to 8 5 0

STEEL (*continued*).

	Home.	Export.
GLASGOW AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 15 0	7 15 0
„ ⅜in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ ⅝in.	9 10 0	8 10 0
„ ¾in.	9 5 0	8 5 0
Boiler Plates	9 5 0	8 5 0
SOUTH WALES AREA—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 0
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ ⅜in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ ⅝in.	9 12 6	8 10 0
„ ¾in.	9 10 0	8 5 0

IRELAND—	BELFAST. £ s. d.	REST OF IRELAND. £ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
„ under 3in.	9 2 0	9 4 6
Plates, ¾in. (basis)	9 0 0	9 2 6
„ ⅜in.	9 5 0	9 7 6
„ ½in.	9 10 0	9 12 6
„ ⅝in.	9 15 0	9 17 6
„ ¾in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

	Home.	Export.
Sheets.	£ s. d.	£ s. d.
10-G. to 13-G., f.o.r.	9 0 0	8 15 0
14-G. to 20-G., d/d	10 5 0	9 0 0
21-G. to 24-G., d/d	10 10 0	9 5 0
25-G. to 27-G., d/d	11 2 6	9 17 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 0 0
2-ton to 4-ton lots	13 7 6
Under 2 tons	15 0 0

Export: £16 12s. 6d., c.i.f. duty paid India.
„ £11 5s. 0d., f.o.b. other markets.
„ Scandinavian Markets free.

Tin-plates.

20 by 14 basis, f.o.b. Bristol Channel Ports, 18/2 to 19/2.
Tin-plate Bars, d/d South Wales Works, £5 7s. 6d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
„ Medium (0·42% to 0·60% C.)	7 2 6
„ Hard (0·61% to 0·85% C.)	7 12 6
„ „ (0·86% to 0·99% C.)	8 2 6
„ „ (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 tons	5 15 0
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
„ Light, f.o.t.	7 10 0

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 15 0	7/–
„ „ 6 p.c. to 8 p.c.	£21 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£21 10 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£34 0 0	11/–
„ „ „ 1 p.c. carbon	£36 15 0	12/–
„ „ „ 0·70 p.c. carbon	£37 5 0	12/–
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose)	£10 15 0 home	
„ Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/– p.u.	
„ „ 75 p.c.	£17 17 6 scale 6/– p.u.	
„ Vanadium	12/8 per lb.	
„ Molybdenum	4/6 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Cobalt	5/6d. per lb.	

NON-FERROUS METALS.

Official Prices, March 13th.

COPPER—		
Cash	£27 13 9 to £27 16 3	
Three months	£28 1 3 to £28 2 6	
Electrolytic	£31 0 0 to £31 10 0	
Best Selected Ingots, d/d Birmingham	£31 10 0	
Sheets, Hot Rolled	£58 0 0	
	Home.	Export.
Tubes, Solid Drawn (basis)	9½d.	9½d.
„ Brazed (basis)	9½d.	9½d.
BRASS—		
Ingots, 70/30, d/d Birmingham	£26 0 0 to £28 0 0	
	Home.	Export.
Tubes, Solid Drawn, 2/1 Alloy	8¾d.	8¾d.
„ Brazed	10¾d.	10¾d.
TIN—		
Cash	£219 0 0 to £219 10 0	
Three months	£214 10 0 to £214 15 0	
LEAD:	£10 10 0 to £10 15 0	
SPELTER:	£11 12 6 to £11 17 6	
Aluminium Ingots (British)	£100	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
f.o.b. Grangemouth)—Navigation Unscreened	13/– to 13/6
„ Glasgow—Ell	16/6
„ „ Splint	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/– to 14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Prime Steam	14/–
Unscreened Navigation	12/6 to 13/–
LOTHIANS—	
(f.o.b. Leith)—Hartley Prime	14/– to 14/3
Secondary Steam	13/– to 13/6

ENGLAND.

YORKSHIRE, MANCHESTER—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	15/– to 17/6
NORTHUMBERLAND, NEWCASTLE—	
Blyth Best	14/3 to 14/6
„ Second	13/3
„ Best Small	10/6 to 11/–
Unscreened	12/6 to 13/6
DURHAM—	
Best Gas	14/8
Foundry Coke	18/– to 20/–

SHEFFIELD—	Inland.
Best Hand-picked Branch	24/– to 26/–
South Yorkshire Best	21/– to 23/–
South Yorkshire Seconds	17/6 to 19/–
Rough Slacks	8/– to 9/–
Nutty Slacks	7/– to 8/6

SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Admiralty Large	19/6
Seconds	19/– to 19/4½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Best Bunker Smalls	13/6 to 14/–
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/– to 26/–
Foundry Coke	24/– to 37/6
Furnace Coke	19/– to 21/6
Patent Fuel	21/–
SWANSEA—	
Anthracite Coals:	
Best Large	34/– to 40/–
Machine-made Cobbles	41/– to 51/–
Nuts	40/– to 50/–
Beans	25/– to 30/–
Peas	19/– to 22/6
Rubbly Culm	10/6 to 11/–
Steam Coals:	
Large	18/– to 20/6

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

Manchester prices ¼d. per gallon extra.

French Engineering Notes.

(From our own Correspondent in Paris.)

Stabilisation and Trade.

THE feeling of something like panic that overtook industrial interests in gold countries during the sharp set back in sterling reveals how precarious is the situation of manufacturers and producers who can only look for safety in a stabilisation of currencies. In the belief that sterling had settled down to a fairly constant exchange rate, industrialists made sacrifices to adapt themselves to that level. Economies in production costs, reduced wages, and a lowering of commodity prices were tending towards a "devaluation" which would lessen the margin between gold and sterling values. The fear that sterling was on the verge of collapse destroyed those hopes. Belgium appealed to France to save the situation by increasing facilities for trade exchanges under the convention for maintaining the gold standard, but it is quite obvious that those facilities are limited by a similarity of products in gold countries and by the impossibility of augmenting preferential quotas without denouncing existing treaties with other countries enjoying most-favoured-nation treatment. In France there was talk of defensive measures, notably a revival of the super tax on import tariffs against all depreciated currencies; but as measures of that kind have reacted disastrously on French industries in the past, it is not clear how it will be possible to impose further restrictions on international trade. The incidents of the past week denote the fragility of the gold standard edifice, with Belgium imploring aid, Italy isolating herself commercially, and Switzerland preparing for a plebiscite on June 2nd next to decide whether that country shall abandon the gold standard. The French are prepared to go to any length to retrieve a situation that threatens danger to the whole European economic structure.

Railway Construction.

After several months of steady increase in the returns of unemployment the figures for the past week show a slight diminution, which can be attributed to the putting in hand of public works, and, particularly, the activity of railway companies in carrying out an extensive programme of construction. On the State system the railway ran through several suburban towns, in each of which level crossings were a serious danger as well as an obstruction, and the raising of the railway level with additional tracks is providing employment and absorbing a good deal of material. There is similar activity on the line to Versailles, and, generally, the railways are contributing their share to the relief of unemployment The transformation of the State railway is probably the most spectactular of any such work that has yet been accomplished. It is observable in big works from Paris to Havre and Cherbourg. When the old Compagnie de l'Ouest had to abandon the working of a hopelessly inefficient railway, and no satisfactory combination could be devised to undertake the huge task of reorganising it, the railway was taken over by the State which has converted it into one of the best-equipped railway systems in the country. Being run with public funds the whole system was reconstructed and it became a laboratory of innovations and experiments, alike in signalling, railcars, and rolling stock. There have recently been put into suburban service double-deck steel coaches which represent the highest mark of modern development of a type of coach that originated with the old Compagnie de l'Ouest. The entire work is a tribute to the skill and initiative of French railway engineers. This complete transformation of the Ouest railway by the State has, nevertheless, entailed a considerable contribution to the total deficit that is causing so much anxiety to the railway companies.

Skilled Labour.

There are many complaints in these times when more than half a million French workers are in receipt of unemployment relief that employers often experience difficulty in procuring skilled labour without having recourse to foreigners, to whom employment is barred, except when their services are indispensable. This is not the fault of the apprenticeship system, which is capable of turning out as many skilled workmen as may be required in the different branches of industry; but many youths who went through apprenticeship schools regarded their training as a stepping stone to higher positions which were made relatively easy by the facility with which diplomas could be obtained. The great majority of youths neglected apprenticeship training during the industrial boom, and were attracted by the high wages offered to specialised labourers, with the result that the elimination of foreigners left an inadequate supply of skilled labour in many branches of industry. There are now far too many engineers and not enough skilled hands. The engineers' associations have been dealing with this matter, and in its annual report the Union des Industries Métallurgiques et Minières remarks on the success that has attended its efforts to induce employers to take on engineers as skilled mechanics and foremen. There are grave doubts whether all those holding engineering degrees will again easily find employment in the profession, and work as mechanics must be found until an industrial revival provides openings for them.

Merchant Shipping.

The Minister of the Merchant Marine intends to introduce into Parliament a Bill to limit the age of merchant ships to fifteen years. The State is able to enforce this limitation by the assistance it renders to shipowners in the way of credit facilities and the shipping bounty, and if these advantages were withdrawn the owner would have to go out of business. The object of the proposed measure is to weed out unprofitable ships and, more especially, to provide work for shipbuilders. If owners of ships more than fifteen years old were required to replace them, there would be work for the shipyards, provided that financial impediments did not stand in the way, as is the case with some other reforms.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator printed are in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

423,208. December 12th, 1933.—HEATING PLUGS, B. Hopps, St. Peter's-road, Rugby; and A. M. Lodge.

For the purpose of initiating an explosion in a compression-ignition engine an electrically heated coil of wire is employed. The device is described as comprising an insulated electrode

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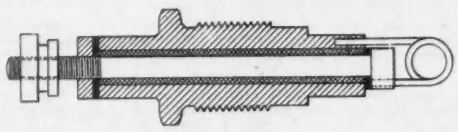

having a metal head at its inner end, and a bent or coiled heating wire having its ends attached respectively to the head and to the body or another electrode, the connection with the head being effected at a position adjacent to one side of the head.—*January 28th*, 1935.

DYNAMOS AND MOTORS.

423,116. September 2nd, 1933.—DEVICES FOR REGULATING SINGLE-PHASE ALTERNATING CURRENT VOLTAGES, Naamlooze Vennootschap Machinerieen-en Apparaten Fabrieken, of Croeselaan 30, Utrecht, Holland.

This invention concerns a device for regulating single-phase alternating current voltages. A is a pair of terminals fed with fluctuating alternating current voltage, and B a lighting system or network fed by this voltage, but from which the voltage fluctuations are to be eliminated. For this purpose a resistor column or element C composed of layers of carbon is inserted in the circuit in series with the lighting system, this resistor element being pressed together by the spring D and more or less unloaded again by the magnet E, so that its electrical resistance varies within very wide limits. The voltage across the

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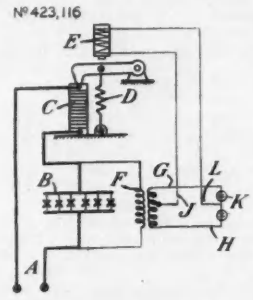

lighting system is connected across the primary winding F of a transformer, whose secondary winding G possesses, besides the two connecting wires G and H, a tapping J. The wires G and H are connected together through two rectifiers K between which a conductor L is branched off and between this conductor and the tapping J the exciting coil of the magnet E is inserted. If an alternating current acts on the primary coil F of the transformer and if there is a connection between the leads J and L, then a pulsatory direct current flows in this connection, the circuit being arranged as for full-wave rectification. The higher the voltage of the lighting system B tends to rise, the more current flows in the magnet coil E, the more the carbon column or resistor C is unloaded, and the greater is the voltage drop.—*January 25th*, 1935.

423,153. June 18th, 1934.—DYNAMO-ELECTRIC MACHINES, Sachsenwerk, Licht- und Kraft-Aktiengesellschaft, of 15, Nordstrasse, Niedersedlitz, Saxony, Germany.

To make possible the casting of the windings *in situ* in a squirrel-cage rotor, it has been suggested to provide metal sleeves

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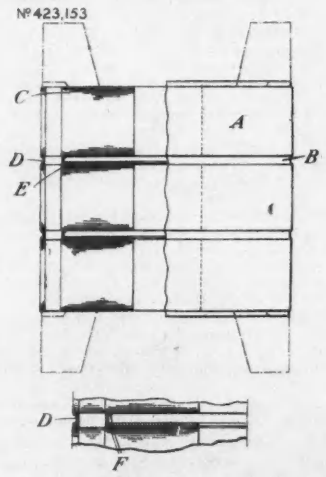

in such a way as to bridge over the cooling ducts. According to the invention, sleeves are provided for bridging over the ducts and are flanged at one or both ends. This gives a wide seating on the packets of laminations and also equalises possible small deviations in the distribution of the slots or tunnels in the adjacent packets of laminations. A is the rotor body, which is subdivided by the cooling ducts B into the individual packets C of laminations. The bridging sleeves D are inserted into the end laminations E, the sleeves being provided with the flanges F at both ends. The sleeves D seat well on the packets of laminations on both sides, as a result of the flanging, so that effective bridging is produced.—*January 25th*, 1935.

SWITCHGEAR.

423,122. September 26th, 1933.—ELECTRIC CIRCUIT INTERRUPTERS WITH ARC EXTINGUISHERS, George Ellison, Ltd., of Wellhead-lane Works, Perry Bar, Birmingham, and James Anderson, of the same address.

The object of this invention is to provide an improved plug and socket interrupting device having combined with it a magnetic arc extinguisher. A circular metal socket A forms one pole of the connection and a metal plug the other pole. The plug is made resilient by constructing it from cylindrical segments B which are mounted on and around an inner tapered part C, and are attached to it at one end by an annular spring D and by screws E passing through holes in the segments, the other ends of the segments being free, so that they can be con-

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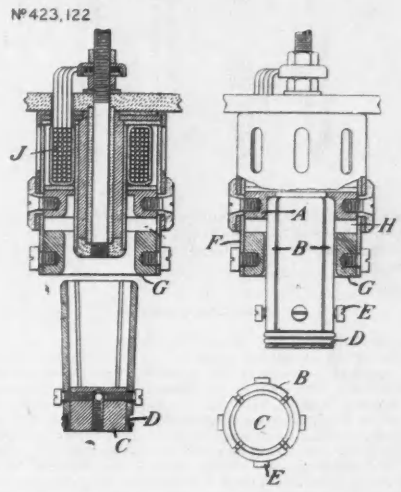

tracted against the action of the spring when pushed into the socket, a tight contact between the plug and the inner surface of the socket being ensured by the spring. Surrounding the socket A is a hollow housing F of insulating material to the inner side of which is secured an extension piece in the form of a metal ring G, the bore of which is rather larger than the bore of the socket, so that when the plug engages the socket it is out of contact with the ring. The plug, however, makes contact with the ring before it enters or after it leaves the socket. The relative disposition of the ring G and the adjacent face of the socket is such as to form an air gap or chamber H in which the arc formed on separating the plug and socket is confined. The magnetic field required for extinguishing the arc is produced by a winding J.—*January 25th*, 1935.

423,424. August 10th, 1934.—ELECTRIC CIRCUIT BREAKERS, Allmänna Svenska Elektriska Aktiebolaget, of Västeras, Sweden.

Two forms of this invention are illustrated, but only one drawing is reproduced here. When an arc is drawn between the stationary contact A and the movable contact B the pressure which then arises acts upwards upon the bottom of the piston C and downwards on the collar D and the bottom of the piston C. As the surfaces upon which the downward force act are greatest

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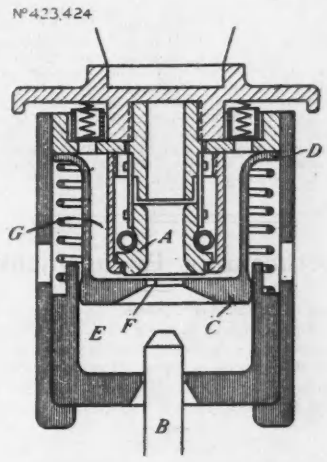


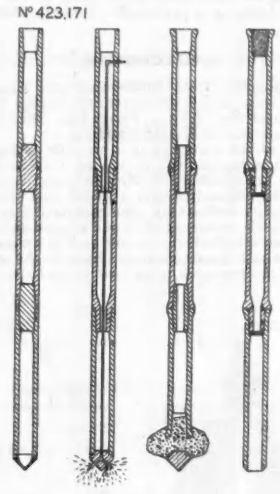
the piston moves downwards and reduce the space E, so that liquid is forced therefrom through the bore F into the space G, thus effectively cooling the arc traversing the bore. The piston is arranged to move downwards at approximately the same speed as the contact B, and will follow the latter at a small distance, so that the bore F will be almost closed by the contact B. The rate of flow of the oil past the contact tip is therefore great during the whole breaking period, and a good cooling action is obtained.—*January 31st*, 1935.

BUILDING.

423,171. June 27th, 1933.—CONCRETE PILING, D. H. Stent, 10, Eldon-road, Hampstead, London, N.W.3.

The objects of the invention are to provide a precast concrete pile which is light in weight and therefore can be economically transported to a distant site from a central factory, at which it can be made in standard unit lengths which can be joined together at the time of driving to give any required length, to provide a precast concrete pile which is hollow and extensible by interjointed lengths, yet is rigid and strong without the hollow tubular structure thereof necessarily being filled with concrete, to provide a pile, the toe of which can be expanded into a bulb if required, and, finally, to provide a pre-

cast concrete pile which needs only a comparatively light and inexpensive plant to drive it, and which is thus economically adaptable to the varying conditions met with in piling work.



The alternative systems of jointing the lengths of piling and the method of making the bulb at the foot are so obvious in the drawings as to need no further description.—*January 28th*, 1935.

METALLURGY.

423,467. February 6th, 1934.—Process of Colouring Oxide Films on Aluminium or on its Alloys, Society of Chemical Industry in Basle (also known as Gesselschaft für Chemische Industrie in Basel), of Basle, Switzerland.

According to this invention, a process of colouring an oxide film on aluminium or an alloy thereof comprises treating the film with an organic dyestuff containing a metal in complex combination. The oxide film on aluminium or an alloy thereof may be obtained by any desired process—for instance, by electrolytic oxidation, such as in a bath containing sulphuric acid, oxalic acid, ammonium bicarbonate, or chromic acid, or by a purely chemical oxidation, such as can be produced in an acid or an alkaline bath containing, for instance, a salt of chromic acid or of hydrofluoric acid or of hydrofluosilicic acid, and, if desired, another heavy metal salt, for instance, a tungstate, a uranate, or a titanate. For this chemical oxidation there may be used a bath containing 3 parts of potassium carbonate, 0·5 part of potassium chromate, and 5 parts of glycocoll in 1 litre of water. The aluminium may be treated in this bath at a temperature of 85 deg. to 100 deg. Cent. for a period of 10 to 60 minutes. As dyestuffs containing a metal in complex combination there may be used the mono-metal compounds, for instance, the chromium, copper, nickel, cobalt, titanium, vanadium, manganese, or iron compound of mono or poly-azo-dyestuffs; also the poly-metal compounds of these dyestuffs or the complex metal compounds of anthraquinone derivatives, triarylmethane dyestuffs, azines, thiazines or oxazines (the complex metal compounds of the four last-mentioned dyestuffs are made in a manner analogous to that for preparing the complex metal compounds of the azo-dyestuffs); also the complex metal compounds of natural organic dyestuffs, such as those of young fustic, old fustic, Persian berries, turmeric, quercitron, ellagic acid, cochineal, logwood, or catechin. The oxide film on the aluminium or its alloy may be dyed in various manners. For example, the film may be treated with a solution of a dyestuff containing the metal in complex combination in water, alcohol, acetone, pyridine, an oil varnish, paraffin oil or a fat. Such a solution may be sprayed on to the oxide film or painted on it, or the dyestuff containing the metal may be printed in the form of a paste on the oxide film. The dye-bath may be neutral and may contain additions such as Glaubers salt, or it may be acid, containing mineral acid or organic acid. The temperature of the dye-bath may vary within wide limits. For obtaining the best results, however, it is in many cases of advantage to suit the temperature of the dye-bath to the degree of hydration of the oxide film, in such a manner that films of a lower degree of hydration are dyed at a higher temperature and films of a higher degree of hydration at a lower temperature. A number of examples of dyeing baths are given in the specification.—*February 1st*, 1935.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the time and place *at which the meeting is to be held should be clearly stated.*

To-day.

Chemical Engineering Group.—Joint meeting with Plastics Group at Chemical Soc., Burlington House, Piccadilly, W.1. "Plastics in a Chemical Works," Mr. M. B. Donald. 8 p.m.

Inst. of Electrical Engineers: N. Eastern Students.—Armstrong College, Newcastle-upon-Tyne. "High-voltage Impulse Testing," Mr. F. M. Bruce. 7.15 p.m.

Inst. of Fuel: East Midland Section.—In Technical College, Lincoln. "The Modern Diesel Engine and its Development," Mr. W. A. Tookey. 7.30 p.m.

Inst. of Structural Engineers: Midland Counties Branch.—At Nottingham. "The Lay-out, Design, and Construction of Aerodromes and Airports," Mr. H. E. Brooks-Bradley. 7 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. Informal meeting. "Old-time Engineers and Experiments," Mr. A. W. Marshall. 7.30 p.m.

Physical Soc.—Imperial College of Science and Technology, S.W.7. Council meeting, 4 p.m.; annual general meeting, 4.45 for 5 p.m.

Railway Club.—At Royal Scottish Corpn. Hall, Fetter-lane, E.C.4. "An Introduction to Railway Heraldry," Mr. G. W. J. Potter. 7.30 p.m.

Royal Aeronautical Soc.—At Inst. of Electrical Engineers, Savoy-place, W.C.2. "New Developments in the Autogiro," Señor Juan de la Cierva. 6.30 p.m.

Royal Inst. of Great Britain.—21, Albemarle-street, W.1. Discourse, "The Art of Printing," Mr. Francis Meynell. 9 p.m.

West of Scotland Iron and Steel Inst.—Royal Technical College, George-street, Glasgow. Council meeting, 6.45 p.m. Annual general meeting, 7.15 p.m.

Saturday, March 16th.

Inst. of Electrical Engineers: N. Midland Students.—Visit to Jowett Cars, Ltd., Idle, Bradford. Permit cards may be obtained from Mr. W. Chambers, 22, St. Ann's-mount, Leeds, 4.

Inst. of Electrical Engineers: S. Midland Students.—Visit to colliery at Polesworth, near Tamworth, belonging to the Pooley Hall Colliery Company, Ltd. 2.30 p.m.

Royal Inst. of Great Britain.—21, Albemarle-street, W.1. "Electromagnetic Radiations," Lord Rutherford. 3 p.m.

Monday, March 18th.

Bradford Engineering Soc.—Technical College, Bradford. "The Storage and Care of Industrial Lubricants in Use," Mr. F. J. Slee. 7.30 p.m.

Engineers' German Circle.—At Inst. of Mechanical Engineers', Storey's-gate, S.W.1. "New Trends of Development in German Refrigerator Design," Prof. Dr. Ing. R. Plank. 5.15 for 6 p.m.

Inst. of Automobile Engineers.—At Inst. of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow, C.2. "Small Marine Engines," Mr. A. G. Pendrell. 7.45 p.m.

Sheffield Soc. of Engineers and Metallurgists.—The University, St. George's-square, Sheffield. "Rolling Mill Bearings," Mr F. T. Bagnall. 7.30 p.m.

Tuesday, March 19th.

British Assoc. of Refrigeration.—At Inst. of Marine Engineers, Minories, E.C.3. "Household and Commercial Refrigeration, with Special Reference to Dry Absorption Machines," Professor Dr.-Ing. R. Plank, of Karlsruhe University. 6 p.m.

Inst. of Civil Engineers.—Great George-street, S.W.1. Discussion. "The Iskandar Bridge, Perak, I.M.S.," Mr. F. G. Coales; "The New Khedive Ismail Bridge, Cairo, Egypt," Mr. F. W. Stephen. 6 p.m.

Inst. of Metals: Birmingham Local Section.—At James Watt Memorial Inst., Birmingham. "Bearing Metals," Mr. R. T. Rolfe. 7 p.m.

Soc. of Glass Technology: Midland Section.—Talbot Hotel, Stourbridge. Second annual dinner. 7.15 p.m.

Wednesday, March 20th.

Inst. of Automobile Engineers.—Metropole Hotel, Leeds. "Small Marine Engines," Mr. A. G. Pendrell. 7.15 p.m.

Inst. of Civil Engineers: Students' Meeting.—Great George-street, S.W.1. "A New Type of Gravity Dam Constructed for the Krängede Hydro-electric Power Scheme (Sweden)," Mr. G. R. Coles. 6.30 p.m.

Inst. of Structural Engineers: Midland Counties Branch, Junior Members' Section.—Star and Garter Hotel, Wolverhampton. "The Detailing of Structural Steel Work," Mr. V. H. Lawton. 7 p.m.

North-East Coast Inst. of Engineers and Shipbuilders: Graduates' Section.—Bolbec Hall, Newcastle-upon-Tyne. "Some Applications of Coal Gas in Industry," Mr. J. Leslie Hobson. 7.15 p.m.

Royal Meteorological Soc.—49, Cromwell-road, S. Kensington, S.W.7. The G. J. Symons Memorial Lecture. "The Propagation of Sound to Great Distances," Dr. F. J. W. Whipple. 7.30 p.m.

Royal Microscopical Soc.—B.M.A. House, Tavistock-square, W.C.1. Meeting, 5 for 5.30 p.m.

Royal Soc. of Arts.—John-street, Adelphi, W.C.2. "Exhaust Noise and the other Noises of Motor Transport," Wing Commander T. R. Cave-Brown-Cave. 8 p.m.

Thursday, March 21st.

Inst. of Mechanical Engineers: Midland Branch.—James Watt Memorial Inst., Birmingham. Thomas Lowe Gray Lecture, "A Survey of Ships and Engines," Mr. Loughnan St. L. Pendred. 6.30 p.m.

Inst. of Mining and Metallurgy.—At Rooms of Geological Society, Burlington House, Piccadilly, W.1. Discussion, "Further Notes on Power Used in Crushing," Dr. John S. Owens. 5.30 p.m.

Inst. of Structural Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. "Stresses in the Steel Reinforcement of Concrete Structures," Mr. R. H. Evans. 7 p.m.

North-East Coast Inst. of Engineers and Shipbuilders: Teesside Branch.—At Cleveland Scientific and Technical Inst., Corporation-road, Middlesbrough. Informal discussion. 7.30 p.m.

Friday, March 22nd.

Assoc. of Ex-Siemens' Men.—Gatti's Restaurant, King William-street, W.C.2. Smoking concert. 7.30 p.m.

Inst. of Electrical Engineers: London Students.—Savoy-place, W.C.2. "Power Plant for Automatic Telephone Exchanges," Mr. K. B. Baldwin. 6.30 for 7 p.m.

Inst. of Engineers and Shipbuilders in Scotland: Students' Assoc.—39, Elmbank-crescent, Glasgow, C.2. "Marine Oil Engines," Mr. D. Carmichael. 8 p.m.

Inst. of Mechanical Engineers: London Graduates' Section.—Connaught Rooms, Great Queen-street, W.C.2. Dinner-dance. 7.30 for 8 p.m.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Education Group meeting. Open discussion, "Technical Training of the Engineering Apprentice." 6 p.m.

Inst. of Mechanical Engineers: Midland Branch, Graduates' Section.—James Watt Memorial Inst., Birmingham. "Steam Generation from the Sensible Heat in Waste Gases," Major W. Gregson. 7.30 p.m.

Inst. of Metals: N.E. Coast Local Section.—In Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. "A Modern Copper Refinery," Mr. R. D. Burn. 7.30 p.m.

Inst. of Production Engineers.—British Industries House, Marble Arch, W.1. "The Finishing of Metals," Messrs. J. E. E. Baskerville and C. W. Benfield. 7.30 p.m.

Inst. of Sanitary Engineers.—Caxton Hall, S.W.1. "The Manufacture of Cast Iron Pipes, with Special Reference to Prevention of Corrosion," Mr. P. H. Wilson. 6 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. "Practical Fuel Oil Burning," Mr. P. C. Griffiths. 7.30 p.m.

North-East Coast Inst. of Engineers and Shipbuilders.—In the Mining Inst., Newcastle-upon-Tyne. "Wake," Mr. G. S. Baker. 6 p.m.

Royal Inst. of Great Britain.—21, Albemarle-street, W.1. Discourse, "Speed," Professor B. Melvill-Jones. 9 p.m.

Saturday, March 23rd.

Inst. of Civil Engineers.—Students' morning visit to Omnibus Depôt of the L.P.T.B. at Chiswick, W.

Inst. of Electrical Engineers: London Students.—Visit to Research Laboratories of the General Electric Company, Ltd., Wembley. 3 p.m.

Inst. of Mechanical Engineers: London Graduates' Section.—Annual visit to works of Messrs. Short Brothers and Blue Circle Cement Company, Rochester.

Royal Inst. of Great Britain.—21, Albemarle-street, W.1. "Electromagnetic Radiations," Lord Rutherford. 3 p.m.

Monday, March 25th.

Inst. of Mechanical Engineers: London Graduates' Section.—Storey's-gate, S.W.1. Annual lecture, "Some Methods of Approach to the Design of Turbine Machinery," Mr. H. L. Guy. 6.45 p.m.

Inst. of Structural Engineers: Midland Counties Branch.—James Watt Memorial Inst., Birmingham. "Reinforced Concrete Structures for the Retention of Water and other Fluids," Mr. W. Hunter Rose. 6.30 p.m.

Monday and Tuesday, March 25th and 26th.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Internal Combustion Engine Group meetings. Monday: election of Committee, reading and discussion of papers on "Supercharging." 2.30 to 6 p.m. Tuesday: reading and discussion of papers on "The Gas Engine as a Competitor in the Power Field." 9.30 to 12 noon. Lunch at Church House, Westminster, 12 to 1 p.m. Visits to works, 1.15 p.m.

Tuesday, March 26th.

Inst. of Electrical Engineers: Scottish Section.—The Freemasons' Hall, George-street, Edinburgh. "Electrical Developments in the U.S.S.R.," Mr. A. Monkhouse. 7 p.m.

Inst. of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C.2. "Paint-making Machinery," Mr. N. N. Mass. 7.30 p.m.

Inst. of the Rubber Industry.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Latex in the Boot and Shoe Industry," Mr. H. Bradley. 7.30 p.m.

Wednesday, March 27th.

Inst. of Fuel.—At Chemical Soc., Burlington House, W.1. "The Properties and Applications of Adsorbtive Carbons," Mr. Hugh Griffiths. 6 p.m.

Inst. of Mechanical Engineers: Yorkshire Branch, Graduates' Section.—Hotel Metropole, Leeds. "Cast Iron," Dr. H. W. Swift. 7 p.m.

Inst. of Structural Engineers: Scottish Branch.—129, Bath-street, Glasgow. "Welding for Steel-frame Buildings," Mr. A. Ramsay Moon. 7.15 p.m.

Newcomen Society.—At Chartered Inst. of Patent Agents, Staple Inn-buildings, W.C.1. "The Order Book of the New Wire Company, Cheadle, 1788–1831," Mr. Loughnan St. L. Pendred.

Thursday, March 28th.

Inst. of Civil Engineers.—Great George-street, S.W.1. Special lecture, "Surveying from Air Photographs," Major M. Hotine. 6 p.m.

Inst. of Electrical Engineers: Scottish Centre.—The Caledonian Hotel, Aberdeen. "Electrical Developments in the U.S.S.R.," Mr. A. Monkhouse. 7.30 p.m.

Inst. of Locomotive Engineers.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Speeding-up of Train Services," Mr. E. W. Selby. 5.30 for 6 p.m.

Inst. of Marine Engineers: Junior Section.—85-88, The Minories, E.C.3. "The Manufacture and Testing of Steel Forgings," Dr. W. H. Hatfield. 7 p.m.

Inst. of Mechanical Engineers: North-Western Branch.—Engineers' Club, Manchester. "The Bend Test and its Value as a Guide to Ductility," Mr. L. W. Schuster. 7.15 p.m.

Inst. of Mechanical Engineers: Scottish Branch, Graduates' Section.—Royal Technical College, Glasgow. "Works Organisation and Control," Mr. L. C. Row. 7.30 p.m.

Inst. of Structural Engineers.—10, Upper Belgrave-street, S.W.1. "The Prevention of Compressed Air Sickness," Sir Henry Japp. 6.30 p.m.

Thursday to Saturday, March 28th to 30th.

Inst. of Physics.—Manchester. Conference on Industrial Physics. For provisional programme see page 210.

Friday, March 29th.

Inst. of Mechanical Engineers.—Storey's-gate, S.W.1. Discussion, "The Bend Test and its Value as a Guide to Ductility," Mr. L. W. Schuster. 6 p.m.

Inst. of Mechanical Engineers: East Midlands Branch.—Technical College, Lincoln. "Stainless Steels," Mr. G. E. Wolstenholme. 9 p.m.

Inst. of Mechanical Engineers: Western Branch.—Merchant Venturers' Technical College, Bristol. "Some Factors in Maintenance Engineering," Mr. A. J. Bowron. 7 p.m.

Junior Inst. of Engineers.—39, Victoria-street, S.W.1. "Notes on the Development of Motor Fishing Vessels in Scotland," Mr. K. W. Willans. 7.30 p.m.

Friday and Saturday, March 29th and 30th.

Faraday Soc.—At Imperial College of Science and Technology, S. Kensington, S.W.7. General discussion on "The Structure of Metallic Coatings, Films, and Surfaces." Daily sessions, 10 a.m. and 2.30 p.m. For details of papers see page 195.

Monday, April 1st.

Engineers' German Circle.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "The Road-carrier for Railway Trucks: A Transport Problem and its Solution," Dr. Hans Culemeyer. 5.15 for 6 p.m.

CONTRACTS AND ORDERS.

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

J. Browett-Lindley (1931), Ltd., Letchworth, have in hand a 130 b.h.p. variable-speed steam engine for driving a board machine at a paper mill near Oslo, Norway. A special feature of this engine is a variable-speed governor, which can be adjusted by hand to give a fine coefficient of irregularity at all speeds between 350 and 40 r.p.m.

International Combustion, Ltd., announces that during February its steam generation division received an order for a stoker-fired boiler from the Briton Ferry Steel Company, and that among the orders placed with its underfeed stoker division there were a secondary air equipment for Preston Corporation; a coal conveyor for Arvind Mills, Ltd.; and an air heater for Bradford Corporation electricity department.

The Buell Combustion Company, Ltd., 49, Moorgate, E.C., has recently secured a contract for coconut drying plant from the Blue Bar Coconut Company, Ltd., Laguna, Philippine Island. The contract covers the supply of three Allen-Buell (Büttner system) vertical turbo dryers, each capable of dealing with 17 tons of wet material every twenty-four hours. Other contracts recently secured by the Buell Combustion Company, Ltd., are extensions to drying plants at the Lincolnshire Beet Sugar Company's factory at Bardney, and at the Second Lincolnshire Beet Sugar Company's factory at Brigg. An Allen-Buell (Büttner system) vertical turbo dryer is being supplied to the British Glue and Chemical Company, Ltd., for dealing with digested bones.